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A STUDY OF PITS AND QUARRIES REHABILITATION

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DEFINITIONS

The following set of definitions are used throughout the study and reflect usage in Nova Scotia and other jurisdictions throughout Canada, the United States and the United Kingdom.

Aggregates

Sand, gravel, slag, or crushed stone used in the construction industry to form concrete, mortar or alone as ballast or grading fill material.

Surface Mining

Mining extraction techniques which employ strip, open pit, contour mining, overcast, dragline, or similar technologies for recovery of the mineral resource. Surface mining refers generally to the associated lands used for dumps, spoils, storage, processing, access roads, sedimentation ponds and drainage works and all other supporting land areas associated with the extraction process.

Pits

Extraction sites in which unconsolidated aggregates are mined employing one or more surface mining techniques. Pits may include sites for extraction of topsoil, clay, peat moss.

Quarries

Open faced sites in which consolidated hard inert material is mined for and processed for aggregate use, building stone, and related uses. Quarries may include tin, coal, gypsum, and dolomite.

Reclamation

A generic term, which refers to the general process of an extracted mineral site being reclaimed with natural regeneration of vegetation and/or thorough planned rehabilitation efforts.

Restoration

Planned restoration of worked and disturbed portions of a site to achieve optimum original site conditions and status; i.e., reshaping of earthworks and drainage patterns to original contours, soil replacement and amendment and replanting to simulate original ecosystems and wildlife habitats. Restoration is usually not feasible especially on large disturbed sites and/or deep pits which are excavated below the water table due to the removal of very large quantities of material.

Rehabilitation

A planned method of returning mineral extracted land to a harmonious form with the surrounding landscape and to a level of biological productivity approximately equal to the previous condition or to another productive use of social and economic value (after Coates/Scott). This process of rehabilitation implies that there are management strategies which are based on an integrated quarrying and rehabilitation plan, and anticipated after uses.

Re-Use/After Use

A process whereby mineral extracted land is re-used for alternative uses other than those in existence prior to or during extraction operations, and usually on those lands where the mineral resource is exhausted. Re-use involves a planned rehabilitation method whereby disturbed land is reclaimed in the interest of some alternative after use such as recreation, industry, residential development or other appropriate land uses.

Progressive Rehabilitation and Sequential Re-Use

Planned methods where the mineral extracted land is rehabilitated and used for new uses in immediate sequence to the extraction process. These approaches may imply that the minerals are extracted immediately prior to an area being developed by otherwise incompatible land uses, e.g., residential subdivision, industrial park, or recreation uses.

The processes are carried out with the objectives of: returning the inactive worked out portions of the land to new economic or social productivity and minimizing the long term environmental and rehabilitation costs to the public and private sectors.

Abandoned/Derelict Sites

Extraction sites left in a condition which is more unsightly, less productive and less useful than is possible and on which no rehabilitation work has taken place. Abandoned sites are normally incapable of beneficial, economic and social use without rehabilitation even though natural rehabilitation activity may have occurred.

Held In Reserve Sites

Sites on which no active extraction is taking place and are being held for future extraction. It may include sites on which only exploratory work has taken place and/or portions of a site yet to be extracted but for which the extent of the resource is known.

Seasonal Sites

These sites include pits used on an intermittent basis for material such as agricultural limestone, sand and gravel during road construction projects (i.e., sites not used in the winter period).

Dormant Sites

Many pits and quarries exist as partially developed sites in which portions of the mineral reserve is lying dormant awaiting changes in market demand and/or improvements to extraction technology enabling the resource to be mined at an economic level at a future time.

Conservation Lands

Restored or rehabilitated mineral land whose intended after use is compatible with environmentally sensitive or hazardous use conditions, i.e., wildlife habitats, water and soil conservation, and natural open space with limited passive recreation activities.

1.0 INTRODUCTION

1.1 Understanding the Problem

This study is concerned with the rehabilitation[1] of land currently or formerly devoted to a pit or quarry operation. The overall reasons for being concerned with land rehabilitation are:

- to return derelict and abandoned land to productive use; and,
- to mitigate environmental, safety and aesthetic impacts of waste land.

Rehabilitation efforts may lead to the restoration or returning the land to its pre-extractive state or, if possible, in some cases the adaptive re-use of the land for a higher and better use in the context of the local community and market forces.

The essential problems associated with restoration are linked to soils, where there is a requirement to amend and stabilize the soil in order that plants on an introduced or natural regeneration basis begin the process of recycling nutrients. This along with proper drainage, engineering works and removal of toxic substances leads to the ultimate goal of creating a self-sustaining ecosystem.

There are a number of reasons why rehabilitation actions are called for:

- Wise environmental management of the land minimizes wind and water erosion, facilitates natural drainage cycles, reduces or eliminates toxicity, and promotes safety through the elimination of site hazards.
- Aesthetic concern for the landscape recognizes inherent values associated with the beauty of a landscape in its natural state.

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1 The term rehabilitation is applied to situations where land devoted to a pit or quarry operation is converted to another use. The conversion will normally involve various activities such as filling, reshaping, planting and other measures. Rehabilitation can occur progressively throughout the life of the pit or quarry operation, or as a single activity at the termination of the extraction cycle. The latter is often referred to reclamation, but rehabilitation will be used to cover both situations in this report.

- Economic incentives which promote rehabilitation when the operation commences. The long term costs to government and society are significantly lower and attractive. The economic benefits from a restored site are far better to the local community than those from a derelict site in terms of land values, marketability of the site for alternative production, and minimization of external impacts.

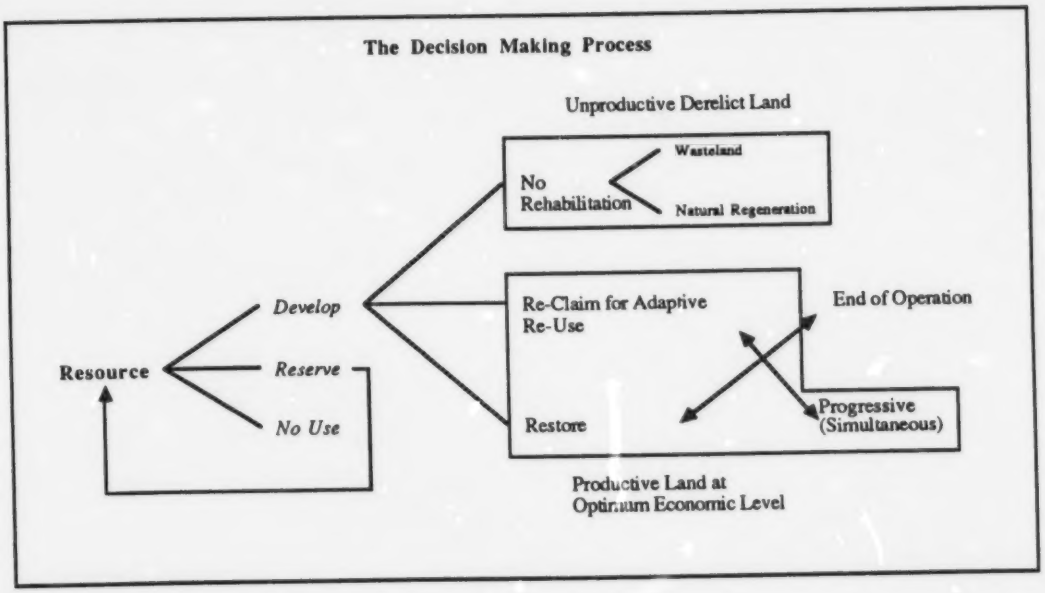
Stated in terms of planning goals and land management, rehabilitation is justified. It facilitates these objectives:

- Planning for changes in land use such that the most disturbed are dealt with first and adjacent lands are left in an undisturbed state;
- Planning for changes in land use to minimize the negative impacts;
- Promoting viable after-use to ensure efficiency and economy of rehabilitation measures;
- Reducing impacts during site operations as disturbance is repaired as soon as possible; and,
- Providing viable after-uses which fit surroundings and meet community needs and planning objectives through local Municipal Planning Strategy bylaws and development application processes.

1.2 Study Objectives

This study was commissioned by Energy, Mines and Resources Canada, in cooperation with the Nova Scotia Department of Mines and Energy and funded under the Canada Nova Scotia Mineral Development Agreement (1984/89). The primary purpose of this study was to formulate a decision making process embodied in different land management strategies that can be applied to derelict land, current workings, and future operations. Specifically, the study identified and investigated cost-effective land management strategies which can be used for the rehabilitation of pits and quarries in Nova Scotia. The management options available are in part determined by the current state of development for a particular operation.

Conceptually, the diagram following helps to illustrate this decision making process.



The secondary purpose of the study was to develop a methodology and criteria to identify potential demonstration projects. Such projects would be an excellent way of demonstrating to local communities and the public at large a provincial commitment toward landscape rehabilitation. Demonstration projects also provide the means to test and evaluate the proposed methodology and establish long term strategies and legislative support. Six sites were identified; they are described in Appendix 6.

Among the specific areas of investigation and work performed are:

- an assessment of the extent to which extraction sites in Nova Scotia are or may be rehabilitated;
- the preparation of an inventory of such sites in Nova Scotia;
- an examination of the experience of other jurisdictions in achieving this objective;

- the drafting of recommendations for legislation that would help achieve this end in Nova Scotia; and
- an assessment of the financial implications for Nova Scotia producers of such legislation.

The members of the study team examined the literature on the subject available in North America, and Europe, visited sites throughout Nova Scotia, interviewed operators of these sites, visited sites in Ontario and interviewed officers of operating companies, the industry association and officials of the Ontario government responsible for the legislation and regulation of rehabilitation.

1.3 The Rationale for Land Rehabilitation

The mining industries of Nova Scotia are important contributors to the provincial economy. They provide income, employment and inputs to other provincial industries. However they may also bring associated disadvantages. The extraction operations can bother neighbors and have sizeable effects on land-use and property values in the vicinity. This can be prolonged; in some instances extraction processes occur over decades and the bother is inflicted over that period. Pits and quarries are not often regarded as desirable neighbours and the industry frequently faces intense opposition to the development of new sites. Preparation of rehabilitation plans during the initial planning stages for a new operation can help to overcome community objections.

In addition, the extraction process can cause permanent physical changes to the land, entailing as it often does, the removal of huge quantities of material. These changes are often such as to convince operators that nothing further can be done with the site at a price each individual is prepared to pay. Consequently, even when extraction has ceased, the land is often not turned to other uses but is merely abandoned.

Such abandonment has a number of effects; it is usually unattractive, producing a devaluation of surrounding lands, a cost which is not borne by the extraction operator, and brings the possibilities of physical danger and environmental degradation.

However, land usually has an alternative potential use. So, to abandon extraction sites after the extraction has been completed is to waste a valuable resource. To the extent that the extractive industries fail to make maximum use of that land during and after extraction, they are imposing needless costs on themselves as well as on the community. They are also missing opportunities to generate economic benefits from the land resource in question. This report argues that the land involved in an extractive pit or quarry operation can always be reclaimed and returned to some productive use. Furthermore, the report argues that this can be achieved at very modest cost by using proper planning and rehabilitation techniques.

This is true also of land use during the extraction process. For example, during the extractive life of a quarry, much of the land will be unused, either awaiting extraction, or exhausted after extraction. This involves a waste of a resource, especially in the case of large sites. By careful planning this land can be put to use during extraction. For example, those areas awaiting extraction may be suitable for uses such as recreation and agriculture on an interim basis; while areas which have been exhausted after extraction may be rehabilitated for suitable after uses such as forestry, agriculture, recreation, housing or commercial developments. This means that the resource is used more effectively and can provide additional revenues.

These practices are called *progressive rehabilitation*. Their adoption can reduce the bother caused during extraction operation and the period over which the dereliction is inflicted on neighboring landowners. *Progressive rehabilitation* also eases the task and can greatly reduce the cost of the rehabilitation of the land. Operators adopting this approach can advance the date at which the land can enter a new revenue earning use.

1.4 The Objectives of Rehabilitation

In a general sense, planned rehabilitation activity should encompass the following objectives:

- Recognize surface mining as a viable economic activity within the Province and as temporary use of land in an otherwise unbroken

sequence of long term economic productivity, such as forestry or agriculture.

- Return mineral extracted land to a sympathetic form with that of the surrounding landscape.
- Return the land to a level of ecological productivity similar to or better than the previous condition.
- Return the land to another social or economic after use which places the land back into productivity.
- Through progressive/sequential rehabilitation, maintain the site in a non-obvious and non-contrasting condition to that of adjoining landscapes.

1.5 The Process of Rehabilitation

The general rehabilitation objectives provide a set of guidelines for planners, policy makers and operators to follow. To make them operational and apply them to a particular site requires operators to develop more detailed site objectives. The items to be considered in the preparation of detailed site objectives include:

- Preparation of an Inventory of Existing Site Features to establish baseline studies prior to extraction with respect to the site's physical parameters such as overburden, vegetation, wildlife habitats, surface and drainage groundwater movement patterns, topographic form, etc.
- Preparation of an Operational Plan based on reserves, extraction methods as well as existing site features and rehabilitation opportunities. The plan must be developed in concert with a Rehabilitation Plan.
- Preparation of a Rehabilitation Plan including:
  - Storage of topsoil where appropriate, subsoil and overburden.
  - Grading and drainage work which facilitates rehabilitation work after extraction activity.
  - Restoration and replacement of topsoil where appropriate and soil amendment work to support planned revegetation.
  - Revegetation work to simulate original species and/or to support alternative after uses.

Where a site has been abandoned or is derelict, the rehabilitation process should involve the following activities, not all of which may apply in any one instance[2]:

- Remove surface blight and foreign debris.
- Reshape the disturbed landscape to achieve visual and ecological harmony with adjoining natural landscape.
- Restore the overburden and topsoil where appropriate to blend with adjacent landscape.
- Re-establish natural ground cover and tree vegetation through habitat identification and replanting.
- Reclaim extraction sites, dumps, fills, spoil areas, staging areas, and administrative sites.
- Reassemble undisturbed portions of the site with rehabilitated portions to form a contiguous site parcel.
- Re-use site for new uses employing innovative development opportunities consistent with local planning objectives and compatible with adjoining land uses.
- The ultimate responsibility for the rehabilitation of derelict or abandoned sites rests with the Province. The role of the Province may vary depending on the site circumstances; for instance, its role may be to facilitate the process of rehabilitation through legislation which would require the landowner and/or operator to rehabilitate the site or by setting a levy on existing operations which would provide a fund for the Province to directly rehabilitate the site.

The remainder of this report is devoted to an examination of how these rehabilitation objectives and processes can and should be applied in Nova Scotia. Chapter Two begins with a description of the study area within the province wherein pit and quarry sites would be catalogued in a study inventory. The chapter

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2 This process should be the responsibility of the landowner. The province should only have to act as the regulatory agent ensuring the necessary action is taken. Where no clean ownership or responsibility can be assigned, the province may have to act directly.

concludes with a profile of the pit and quarry industry in Nova Scotia, and an overview of the rehabilitation situation in the province. A review of the legislation governing the rehabilitation of pits and quarries in Nova Scotia, other provinces in Canada, Great Britain and the United States is presented in Chapter Three. Chapter Four discusses the rationale for rehabilitation, the costs of rehabilitation and the various policy instruments available to encourage and require rehabilitation practices by operators. An outline for a proposed rehabilitation handbook for operators is presented in Chapter Five. The handbook to be drafted following the proposed outline would be distributed to all pit and quarry operators in Nova Scotia as part of greater commitment to rehabilitation on the part of the Province. The study recommendations are presented in Chapter Six. Chapter Seven concludes the report with summary descriptions of six proposed demonstration sites for pit and quarry rehabilitation in Nova Scotia. Further detail on the material contained in the chapters of the main report is provided in the study appendices.

2.0 THE INDUSTRY IN NOVA SCOTIA

2.1 Study Area and Inventory Criteria

The study area was determined in consultation with the client to include disaggregate geographic areas of the Province in order that a range of geological types might be inventoried, together with sites which represented one or more classifications under the Classification System. Coal operations were excluded because the majority of the sites are below surface workings and do not fall within the definition of pit or quarry operations.

This approach has resulted in sites being selected in two geographic corridors. One runs from the Halifax Metro Region to Windsor, Truro, and Musquodoboit, and a second from Port Hawkesbury to River Denys and Marble Mountain on the Bras d'Or Lakes.

The geological regions include the Meguma, Windsor, Horton and George River series, thereby covering the principal regions where extensive surface mining operations are taking place.

The Classification System encompasses sites which range from abandoned sites where no rehabilitation activity has occurred to fully rehabilitated sites in non mining after uses. Sites which are in urban as well as rural locations have been included and short term operations (0-10 years) through to long term operations (40 years plus) under the Classification System were inventoried. The scale of operations inventoried ranges from very large sites operated by multinational corporations to small local operators which only open up their pits on an infrequent basis.

The purpose of selecting a study area and establishing inventory criteria as outlined was to provide a comprehensive cross section of site types subject to a variety of rehabilitation approaches. The following map identifies the Nova Scotia sites inventoried. Detailed information on each Nova Scotia site as well as several Ontario sites is contained in a Technical Report under separate cover (see Appendix

1 Sugar Camp
2 River Denys
3 Marble Mountain
4 Musquodoboit Bulk Sampling
5 Musquodoboit Silica Sand Pit
6 Hardwood Lands
7 Shubenacadie Buff Clay Pit
8 Milford Shale Pit
9 L.E. Shaw Red Clay Pit
10 National Gypsum
11 Gateway Materials
12 Williams Lake Road
13 Wentworth Quarry
14 Miller Creek Quarry
15 Conrad Pit
16 Kelly Pit
17 Kelly Stock Pile

PITS AND QUARRIES – INVENTORY SITES – NOVA SCOTIA

Two for Inventory Form). A synopsis of the sites with respect to rehabilitation activity and other classification data is provided in Table 2.1.

2.2 The State of Rehabilitation and Reclamation in Nova Scotia

The Industry

The production of aggregates and structural materials by mining and quarrying is a significant part of the extraction industry in Nova Scotia, and plays an important part both as an employer and as a supplier of essential materials to other industries. Mining generates income and employment directly. In 1985/86, the surface extraction of aggregates and industrial minerals employed over 1660 people at 102 sites[3]. These sites are frequently large covering several hundred acres. In addition there are also an unknown number of much smaller sites, whose operation is not always registered with any government department and which may often be abandoned after production ceases.

The industry also generates income and employment indirectly by supplying the raw materials that receive further processing within the Province. Thus, an additional 156 were employed in the manufacture of cement and brick derived from the extraction of clay and limestone.

With the exception of gypsum, the processing of which takes place out of province, the clay, limestone, aggregates and structural materials produced in province are used in processed form (or indirectly) by the building and construction industries in the Province. In consequence, the prices at which these products are supplied have an effect on the level of building and construction output and employment.

Aggregates are exported to the southern United States, and limestone to Newfoundland and Prince Edward Island.

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3 Note that the Department of Transportation lists 210 sites in its records. The discrepancy is most likely explained by the inclusion of inactive or sporadically active sites in the DOT figures.

Table 2.1
Classification System

Site Location	Location	Owner	Type	Duration	Reclamation Activity	
1. Sugar Camp	Port Hawkesbury Cape Breton	Georgia-Pacific Corp.	Gypsum Active	Long Term 40 + years	Progressive Rehabilitation	Rural
2. River Denys	Port Hawkesbury Cape Breton	Georgia-Pacific Corp.	Gypsum Active	Med. Term 0-40 years	Experimental Reclamation	Rural
3. Marble Mountain	Cape Breton Richmond	Provincial Government (Lands & Forests)	Marble Inactive	Long Term 40 + years	None	Rural
4. Musquodoboit Bulk Sampling	Musquodoboit	Mineral Rts. NSSG Land - Scott Paper Inactive Reserve	Silica Sand Exploratory Site	Unknown	None	Rural
5. Musquodoboit Silica Sand Pit	Musquodoboit	Mineral Rts. NSSG Land - Scott Paper Private	Silica Sand Rehabilitated Site Inactive	Short 0-10 years	Rehabilitated, in After Use	Rural

Site Location	Location	Owner	Type	Duration	Reclamation Activity	
6. Hardwood Lands	East Hants	NSSG	Sand & Gravel Storage Area for Imported Minerals Active	Long Term 40 + years	Partial Rehabilitation	Rural
7. Shubenacadie Buff Clay Pit	Shubenacadie	NSSG	Clay Some Silica Sands	Med. Term 10-40 years	Partial Rehabilitation	Rural
8. Milford Shale Pit	Milford	NSSG	Shale Active and Inactive	Med. Term 10-40 years	Partial Rehabilitation, in After Use	Semi-Rural
9. L.E. Shaw Red Clay Pit	Lantz	L. E. Shaw	Clay Active and Inactive	Long Term 40 + years	a) Partial Rehabilitation b) Rehabilitation Complete c) In After Use	Semi-Rural
10. National Gypsum	Milford Halifax Co.	N. Gypsum Private	Gypsum Anhydrite	Long Term 40 + years	Partial Rehabilitation	Rural
11. Gateway Materials Ltd.	Halifax Kearney Lake Road	Laurie Stevens Ann. Basin Pulp & Paper	Quartzite Granite Active	Med. Term 10-40 years Nearing End of Term	None	Urban

Site Location	Location	Owner	Type	Duration	Reclamation Activity	
12. William's Lake Road	Halifax	Dept. of Public Works	Ironstone Abandoned	Med. Term 10-40 years	None	Urban
13. Wentworth Quarry	Windsor, N.S.	Fundy Gypsum Company Ltd.	Gypsum Anhydrite	Long Term 40 + years	Partial Rehabilitation	Semi-Rural
14. Miller Creek Quarry	Brooklyn, N.S.	Fundy Gypsum Company Ltd.	Gypsum Anhydrite	Long Term 40 + years	Partial Rehabilitation	Rural
15. Conrad Pit	Chezzetcook, N.S.	Garnet Conrad	Quartzite	Short Term 0-10 years	None	Rural
16. Kelly Pit	Middle Sackville, N.S.	Lewis Kelly	Fill-Clay	Short Term 0-10 years	None	Urban
17. Kelly Stockpile	Lower Sackville, N.S.	Lewis Kelly	Glacial Fill	Short Term 0-10 years	None	Urban

Appendix One provides further detail of the income and employment generated by the aggregate and industrial minerals industry.

Overview of Rehabilitation

With few exceptions, planned rehabilitation activity on surface mining operations in the Province has been negligible and it is only within the past few years that a select group of operators are undertaking experimental reclamation activity on worked out and near end of term operations, especially on quarry dump sites through regrading and planting of herbaceous vegetation or trees. Reclamation activity has also centered around efforts to address environmental concerns such as erosion control, down slope sedimentation, and pollution control of both air and water.

Historical Considerations

Until recently, the Province has not had legislation directed toward rehabilitation. What legislation does exist is concerned with pollution control and bonding requirements for restoring the land with properly graded slopes and vegetative cover. The lack of comprehensive rehabilitation legislation and the level of interest in rehabilitation by surface mining operators has combined to produce only minimal rehabilitation efforts.

Until quite recently, the pressures of public opinion have not produced significant results on either government or operators. Many mining operations are in isolated areas, visible only to a few local residents, and in numerous situations the operations are an important source of local employment. The further the pit or quarry site is from settlement or urban activity, the lower the perceived need is to carry out rehabilitation or visual screening of the operation. In many cases, the initiative to rehabilitate has simply been an internal corporate management decision, and does not seem to be based on after use economics.

Most rehabilitation activity has been experimental, based on a remedial approach to control erosion and to replant with various species of herbaceous cover. Some early planned rehabilitation has involved visual screening of dump sites and

edge of quarry or pit areas. The concern has been primarily to obscure the operation from public view and secondarily, to grade and replant in a manner so that the site will blend and blur in with surrounding landscapes.

Very little thought, if any, has been given to the after use of pit and quarry sites. In many cases, the value of the mined resource far exceeds the value of the land in its original state, i.e., scrub forest or grass-lands, or that of chosen after uses. Although most operators do value their land, they may not appreciate its full value in alternative uses after the mineral resource has been exhausted. Our study suggests that where there has been rehabilitation work, it has not been based on a comprehensive rehabilitation plan or in many cases even a quarry operation's plan. In most cases the operators have yet to perceive the need for rehabilitation planning. Operators seem to be struggling with how to effectively carry out rehabilitation and much of the work to date has been based on an engineering approach in contrast to a management strategy and conceptual design approach for rehabilitation and after use.

The majority of the sites which have been either partially or wholly reclaimed are in after uses of low economic value such as unharvestable grassland. Several exceptions though, are sites which provide excellent habitats for waterfowl and bird life. These after uses should be recognized as important components to the environmental and economic health of the community. They are often a more viable after use in a rural area than forestry or recreation.

Changing Attitudes

Some significant shifts in attitude are taking place. Operators, especially the larger corporate concerns, are beginning to recognize the importance of rehabilitation, if for no other reason than improving local community relations. Larger concerns tend to take a longer term view and realize that the development of new deposits and opening of new sites will be actively opposed by communities unless they can be convinced that extraction operations will be accompanied by progressive rehabilitation.

Of overriding concern on the part of operators is the cost associated with rehabilitation. However, it is clear that rehabilitation carefully planned and implemented will have relatively little, if any, impact on operators' costs. In addition if rehabilitation is required of all operators then no individual operator is placed at a competitive disadvantage in the marketplace.

The difficulty is likely to lie in ensuring that rehabilitation is well planned and implemented. The field is new in Nova Scotia, experience is limited and successful examples are few. Thus, the provision of expertise will be of crucial importance in enabling operators to conduct rehabilitation and in enabling them to do so in as efficient and cost effective manner possible.

The experience of rehabilitation legislation in southern Ontario strongly supports the belief that the costs of compulsory rehabilitation are extremely minimal in relation to overall extraction costs prior to extraction when the rehabilitation is planned and conducted efficiently. The operational details of such a scheme can also be designed so as to minimize the effects on operators cash-flow positions. However, the southern Ontario experience is based on a simple geology and soil and climatic conditions more favourable for a wide range of mine site re-use projects. Translating the Ontario experience to Nova Scotia will not necessarily be straight-forward.

It is also of particular importance in implementing any rehabilitation legislation that all operators in a similar resource base be treated alike which gives them equal status in the marketplace. It is especially important therefore that government involvements in surface mining such as the Department of Transportation's extraction of aggregates either directly or under private contract be subject to rehabilitation legislation and enforcement also. To do otherwise would be to legislate a slight competitive disadvantage for those operators who do rehabilitation work. Avoiding such inbalances is very important.

There is a consciousness among a number of the operators that rehabilitation is important and an issue that must be addressed in a much more concerted manner in the future. At the very least increasing environmental control and public

relations will require this. However, the understanding of how to conduct rehabilitation and the issue of the long term social value of rehabilitation and future land use have yet to be addressed in any significant way. As one operator put it, "we're very good at mining, but perhaps we need more than a mining engineer's approach to rehabilitation".

Another conclusion from the inventory process bears mentioning. Every site and operation is different. Potential rehabilitation strategies and after use options are distinctly different from site to site. Short term, shallow extraction pits which are close to urban areas, or those used as temporary aggregate pits for highway or construction work, are relatively easy to rehabilitate and offer a variety of potential after uses.

In contrast, long term operations, with deep pit and/or large exposed quarry faces present a significant challenge to rehabilitation, particularly when situated in isolated areas. The problem is exacerbated as so few of the older operations have ever received any rehabilitation work. Few operators have had the foresight to stockpile topsoil and overburden in a manner which is reusable in rehabilitation activity. Some operators have sold off topsoil as part of their operational plan, leaving little option for replacement at a later date.

Progressive rehabilitation, whereby the operator develops a quarry plan, together with a rehabilitation plan and actually carries out the practice of rehabilitating those portions of the site recently extracted is an exception to normal mining practice, yet it offers the potential for actually reducing extraction costs. Several companies are awakening to the potentially lower costs associated with progressive rehabilitation and are beginning to develop rehabilitation plans prior to the extraction process. Examples of successful progressive rehabilitation activity from other areas are also commanding attention. The good neighbour policy is showing signs of focusing attention on the economic and social value of carrying out progressive rehabilitation.

Attitudes within government are changing, as a core of civil servants are beginning to become actively involved in researching and testing rehabilitation strategies. They are initiating work at both the research and operator's levels.

Legislation governing surface mining has been directed toward mining safety, pollution control for groundwater quality maintenance and wildlife habitats. Most of the more important surface mines in the Province are not subject to regulation either because they pre-exist or are specifically exempt from recent legislation. These factors, together with the very limited staff available to enforce legislation or encourage innovative approaches, has meant most rehabilitation activity is of a remedial nature. Most rehabilitation is still confined to earthworks such as berming which is intended simply to conceal, rather than to rehabilitate the land. With only a few exceptions such as Catalone and Lantz, the sites are still a strong visual reminder that there is a need for comprehensive legislation and enforcement.

Summary

Rehabilitation has received relatively little attention in Nova Scotia until recently and the question of the re-use of land has received even less. The Province has had little legislation directed towards rehabilitation. Where rehabilitation has been practised it has been largely experimental or seen simply as a device to conceal unsightly operations from public view. Attitudes are changing however, both public opinion, and government officials are becoming more concerned. Operators of pits and quarries are aware that increasingly they will be required to carry out some level of rehabilitation but their prime concern at present is the impact on their costs of operation. The evidence of the Ontario experience, where rehabilitation has been required for seventeen years should serve to allay these fears. Progressive rehabilitation, properly carried out, is not costly. It does, however, require a type and level of expertise which is currently scarce in Nova Scotia. The expertise required is that which is needed to develop and design comprehensive rehabilitation plans which mesh with mining operation plans. The development of these plans may be contracted out and/or provided by the Province. In either case, these skills will need to be developed further within the Industry, the Consulting Field and Government.

3.0 LEGISLATION

As part of this study, a review of legislative practices relating to the rehabilitation of pits and quarries was conducted. Below are brief descriptions of six selected jurisdictions within Canada, Great Britain and the U.S.A.

3.1 National Practice

Nova Scotia

Rehabilitation legislation governing non-mineral pit and quarry operations in Nova Scotia does not exist (non-minerals are those included in Section 2 (K) of the existing (1975) Minerals Resources Act). However, there are seven Nova Scotia Government Departments which have some involvement with the control of non-mineral pits and quarries. These Departments are Mines and Energy, Environment, Transportation and Communications, Labour, Health and Fitness, Municipal Affairs and Lands and Forests. The controls for rehabilitation for pit and quarry operations falls mainly within the jurisdiction of the Department of Environment under the Environmental Protection Act. Under this Act, there are two sets of guidelines which stipulate site rehabilitation techniques. These are the "Pit and Quarry Guidelines" and "Environmental Guidelines for Surface Mining". The former guidelines stipulate that the operator must post a security bond on a dollar per hectare basis. Bond money is refundable as rehabilitation is completed. The rationale for rehabilitation involves limiting the extent of environmental damage and the restoration of habitat where possible.

Both sets of guidelines stipulate that operators should re-contour and re-vegetate with herbaceous plant material. Progressive rehabilitation is encouraged in both instances whenever possible. The guidelines were introduced in the 80s and companies in operation prior to this time have not all been brought under these guidelines. The older gypsum operations in Nova Scotia are an example of this. In addition, there are a number of small operations not aware of the guidelines and who therefore, have not registered.

The Nova Scotia Department of Transportation and Communication, who are producers and users of the aggregate resource are not subject to existing guidelines. However, the Department is aware of the guidelines and utilizes them when contracting services from private operators.

Further detail of the legislative jurisdiction which impact on pit and quarry operations in Nova Scotia is found in Appendix Three.

In general, there is a lack of substantial legislation to ensure comprehensive rehabilitation of sites disturbed through the exploration and operation of non-mineral pits and quarries. Below is a brief summary of weaknesses found with existing practices:

1. The requirements for the rehabilitation of non-mineral and pits and quarries and for the system of security deposits for pits and quarries arise only from guidelines established under the Environmental Protection Act and have no Cabinet endorsement nor legislative status.

2. Rehabilitation and after use of non-mineral pits and quarries are given only minimal attention by operators and government when licenses and permits are granted. Until 1988/89 permits were granted for indefinite periods. Small backyard operations in particular seldomly rehabilitate their property due to a lack of awareness about rehabilitation in general and/or to a lack of enforcement of the guidelines.

3. There is no provision for the restoration of sites abandoned before the practice of security deposits.

4. The rehabilitation of pits and quarries that is conducted appears to be limited to contour grading and planting for stabilization.

5. There is a multiplicity of Departments involved in the control of non-mineral pits and quarries (i.e., Department of Mines and Energy, Department of Environment, Department of Lands and Forests, Department of Labour, Municipal Authorities) with no clear jurisdiction, especially in the minds of operators.

6. There is a lack of personnel to monitor and supervise rehabilitation of non-mineral pits and quarries at both provincial and local government levels. (There are only three enforcement persons for Pits & Quarries with Department of Environment.)

Since the review of existing regulations, steps have been taken which will set in motion the monitoring of environmental impacts of pit and quarry operations. These are as follows:

1. The Environmental Protection Act regulations pertain to any pit or quarry in excess of four hectares.

2. The existing Pit and Quarry Guidelines have been drafted into regulations and are expected to become law by the end of 1990. These guidelines have been tightened to require a rehabilitation plan prior to approval, and an increase in the performance bond from $2,000 per acre to $4,000 an acre. Furthermore, the Department of Environment is considering the adoption of controls similar to the Ontario Pit and Quarry Control Act which will give them better control over the industry, especially with regards to rehabilitation.

3.2 National Practice Summary Chart

Table 3.1 provides a summary of the Security Deposit requirements for the rehabilitation of pits and quarries in Canada. The information provided has been extracted from "Land Use In Canada Series, Number 23, Mining, Land Use and the Environment, 11. A Review of Mine Reclamation Activities in Canada, Environment Canada".

Ontario

Ontario introduced a requirement for rehabilitation with the Pits and Quarries Control Act of 1972 and has had seventeen years experience in the operation of an act requiring rehabilitation.

The Pits and Quarries Control Act of 1972 requires operators, other than operators of wayside pits, to provide plans for the rehabilitation of their sites and to pay a levy on each tonne of material extracted, up to a maximum per hectare. The proceeds of this levy are refunded as rehabilitation proceeds and are forfeited if rehabilitation is not done. The sites are inspected annually by trained inspectors who regulate the quality and nature of the rehabilitation performed.

An additional levy is also collected to rehabilitate abandoned sites and to compensate municipalities and regions and to administer the act.

Table 3.1
A Summary of Rehabilitation Regulations in Canada

Province	Acts and Regulations	Security Deposit and Bonds	Comments
Newfoundland	Quarry Mineral Act 1977	Deposits required.	Formula not yet determined.
Prince Edward Island	Excavation Pits Regulation 1976	None indicated.	
Nova Scotia	Dept. of Environment Environmental Protection Act Pit and Quarry Guidelines 1988 Dept. of Environment Environmental Guidelines for Surface Mining Operation	 $2,000/acre of active area. Minimum $5,000 bond requirement.	
New Brunswick	Mining Act 1971 Mining and Waste Disposal	$500/acre for surface.	
Quebec	Pits and Quarries Control Act 1977	- $5,000 if less than one hectare. - $4,000 per hectare if greater than one hectare. - $50,000 if there are greater than five pits for one project.	
Ontario-Southern	Pits and Quarries Control Act 1971 Bill 170	- 8¢ per tonne, to a maximum $6,000 per hectare. - Progressive rehabilitation minimum of $1,000 per hectare. - 6¢ per tonne.	Money only refunded when rehabilitation is complete.

Table 3.1 (Cont'd)
A Summary of Rehabilitation Regulations in Canada

Province	Acts and Regulations	Security Deposit and Bonds	Comments
Manitoba	Quarry Minerals Regulations 1976	- $5,000 not in excess of $50,000 for the owner of more than one pit or quarry. - Casual permits, 5¢/cu.yd. $3,000 or $20/ac., whichever is greater for exploration permits.	
Saskatchewan	Dept. of Environment Act 1972 Minerals Resources 1972 Coal Conservation 1976	Per hectare performance bond. $500 first acre, $350 for each additional one. Per hectare performance bond.	
Alberta	Land Conservation and Reclamation Act	- Surface coal $5,000 for a small mine, $25,000 for larger ones. - An additional security deposit may be levied based on a rate/tonne. For sand, gravel, clay and marble, there is a security deposit of $250 per acre.	
British Columbia	Mines Act 1981	Security not to exceed $2,500/ha used or to be used.	Money will not be refunded if rehabilitation not completed.

The 1972 Act is being replaced with legislation set out in Bill 170 of the Ontario Legislative Assembly. This Bill includes a provision for the Minister to suspend the operating license of an operator who fails to comply with rehabilitation requirements and requires operators of wayside pits to provide plans for rehabilitation and pay a lump sum security deposit before extraction begins. This step provides an enforcement measure to ensure rehabilitation.

The new act also reduces the scope for municipalities to prevent extraction by the use of zoning bylaws but allows municipalities to comment on a review of each site every four years.

See Appendix Four for further detail.

Alberta

The Land Surface Conservation and Reclamation Act 1983 provides that disturbed land is returned to the same productivity as the site was capable of prior to disturbance.

Rehabilitation Officers from the Departments of Forestry, Lands and Wildlife and the Department of the Environment are responsible for the inspection of rehabilitation requirements.

Security deposits for rehabilitation of surface coal mines, sand, gravel, clay and marble operations is required. The formula for the deposits vary and is outlined in the chart in Table 3.1.

See Appendix Four for further detail.

3.3 International Practices

United States

The primary rehabilitation legislation in the United States is the Federal Surface Mining Control and Reclamation Act 1977, directed toward the rehabilitation

of surface coal operations. Individual States may enact more stringent legislation but they must, as a minimum, adhere to the Federal Act.

The Act provides for a national environmental protection and rehabilitation program for surface coal mining sites. Rehabilitation must meet the standards of performance set forth in the Act. The Act controls water pollution and protects scenic areas. Performance bonds are required for the rehabilitation of existing sites and a levy is set for the reclamation of abandoned sites. Site rehabilitation must be to at least a level which would support uses for which it was capable of supporting prior to operation.

See Appendix Four for further detail.

Britain

In Britain rehabilitation legislation for the planning and funding of restoration for coal and ironstone operations has been active since the 1940s and 1950s. The 1947 Town and Country Planning Act was the first piece of legislation which required the rehabilitation of sites after closure. In addition to site rehabilitation, the Act recognized the importance of protecting potential resources and placed greater planning and control with local authorities. This recognition continued through its inclusion within the 1968 and 1971 Town and Country Planning Acts, and the 1981 Minerals Bill.

The setting of a levy on mineral extraction for the purpose of site restoration dates back to the Mineral Workings Act of 1951, and in a broadened form continues today.

The 1981 Bill provides:

- for bonds to be posted for land reclamation;
- for a set of standards of operating techniques to be defined before starting a new pit
- for the use of a conditional permit to work minerals that require progressive rehabilitation work and that working practice be assessed yearly prior to authorization of new permit to operate.

See Appendix Four for further detail.

Scotland

A Policy for Aggregate Extraction prepared by the Grampian Regional Council in Scotland developed a three tier system for controlling and planning aggregate extraction. The tier system sets up a hierarchy for designating areas capable and suitable for aggregate extraction. The first tier is the most restrictive while the third tier is the least restrictive. Land uses within the first tier would include such land uses as top quality agricultural land, National Nature Reserves, and Statutory Conservation Areas.

The aims and functions of the aggregate policy are as stated in the report:

- to ensure adequate available quantities of aggregates, with planning permission for their extraction, to meet market requirements;
- to identify important types of the Region's environment and ensure that they are not irreparably ruined by mineral extraction;
- to ensure that planning permissions, where granted, are subject to uniform minimum standards of development control;
- to assist operators in identifying areas considered for mineral extraction.

The Grampian Region is one of the more progressive planning regions in Scotland and has established procedures for rehabilitation activity in advance of other areas.

Summary

There has in most jurisdictions been a trend towards progressively more stringent requirements for rehabilitation and in this sense, Ontario leads the way within the Canadian context and to some extent within the United States also. This has been possible in part because operators have become more familiar with the techniques and potential for rehabilitation, and in part because public opinion has supported it. It has, however, often been combined with a trend to protect both the availability of the resources and specific features of the landscape. Rehabilitation is becoming a part of the process of determining land uses.

4.0 REHABILITATION: RATIONALE, COSTS AND INSTRUMENTS

4.1 Rationale

The rationale for requiring progressive site rehabilitation of all extractive operations are three:

- Rehabilitation returns a valuable resource to some use thus achieving a social benefit;
- It achieves a remedy for the harmful effect an abandoned site may have on neighboring properties, i.e., it reduces an external cost imposed on others who have no individual remedy;
- By making the requirement universal, it removes the competitive disadvantage any operator who rehabilitated unilaterally would suffer. This is the classic argument for government intervention. An individual operator is often prepared to rehabilitate but only if all his competitors do likewise. However, the individual operator cannot compel his competitors to do so and voluntary multilateral agreements rarely work. Only the government can ensure universal compliance.

4.2 The Costs of Rehabilitation on Typical Sites

Examples of three sites are described to illustrate costs of rehabilitation. One example is from Nova Scotia while the other two are Ontario case studies.

The two examples of rehabilitation from Ontario have been translated into the Nova Scotia cost environment. If the physical requirements of the Ontario sites can be taken as applicable to a typical Nova Scotia site, then the examples will represent a rehabilitation relevant to the Nova Scotia situation.

In the case of Ontario, the examples are atypical in that the rehabilitation was conducted to a higher than average standard which resulted in a higher than average number of man-hours and equipment-hours being spent on it. Thus this may be taken as representing points on the upper end of the range of rehabilitation costs

All examples demonstrate progressive rehabilitation, where the land is rehabilitated a section at a time while extraction continues. The costs relate to 1988.

Example One: Ontario Sand Pit Progressively Rehabilitated to Grass

An eight hectare area of a sand pit was rehabilitated to grass. The total site covered 66 hectares. The area rehabilitated comprises pit floor and face. Extraction took place in two lifts. The face over the whole site varies between 18 to 30 metres. In the area to be rehabilitated it is 21.5 metres deep and extends on two sides for some 123 metres in length. In the rehabilitation, these faces are sloped to a 12% slope using the overburden which had covered the deposit to a depth of eight feet. The site was then recovered with topsoil. Since there was insufficient topsoil to cover the surface to the 13.5 centimetres necessary, it was enhanced with a cellulose waste product from recycled paper. This is available delivered free from a nearby paper producer. The height of face was not uncommon, and while there is no 'average' site, this might be regarded as a typical sand pit site.

This rehabilitation was conducted to a very high standard by a company that enjoys a reputation for the quality of its rehabilitation efforts. This is reflected in both the amount of regrading to produce a 12% slope suitable for agricultural, equipment and in the conditioning treatment of the soil after it was spread.

It was also a 'difficult' site in that it was severely compacted and required much ripping with an expensive piece of equipment.

There was a further factor which tended to increase the costs of this particular rehabilitation. The costs of hauling the topsoil and subsoil could have been reduced but for various reasons that made the operator reluctant to change the location of settling ponds. This resulted in the storage berms for the soil materials being located at a distance from the rehabilitation site and considerably increased the haulage of soil. This is of significance under the Ontario scheme as only half of the costs of hauling soil materials are reclaimable against the security deposit. (Half the haulage cost is assumed to be part of the costs of extraction.)

The rehabilitation process required:

- surveying the site;
- regrading and contouring;
- hauling and spreading soil materials;
- removing rocks and enhancing the soil;
- fertilizing and seeding.

The rehabilitated portion of the site finally was leased to a neighbouring farmer for pasture. The costs of the process are summarized below. More detailed costs are presented in Appendix Five.

Table 4.1
The Costs of Progressive Rehabilitation of an Eight Hectare Sand Pit

	Per Hectare	*Total*
Grading and Recovering Costs	$8,223	$65,790
Cultivation Costs	$ 650	$ 5,209
All Costs	$8,873	$70,999

Sources: "The Cost of Rehabilitating to Agriculture" Peter M. Robinson, TCG Materials Ltd.
Nova Scotia Department of Agriculture Farm Management Fact Sheet "Average Costs of Grass Hay Production"
Nova Scotia Road Builders Association
Gardner Pinfold Consulting Economists Limited

Rehabilitation in Context

The cost of rehabilitation, $71,000 ($80-90,000 allowing for a rehabilitation plan) for the eight hectares is a significant sum but it will be incurred over a period of at least two years. Also, it assumes no relationship between overburden stripping and final grading and seeding.

It should also be put in the context of the wealth generated from this section of the site. If, as was the case, the site yielded a 12.2 metre deposit over the entire eight hectares rehabilitated, it would have yielded nearly two million tonnes of sand and gravel from this portion of the site. (Fifteen percent of output was too fine for use and was lost.) Under a levy scheme as operated in Ontario the funds would be raised over the entire extractive life of this section of the pit during which time two million tonnes would be extracted and sold. The proceeds of an eight cent per tonne levy applied to the same volume would have yielded $117,500, allowing for a 15% loss of fines.

Calculating revenues requires assumptions to be made about the quality of sand and gravel produced and the price earned. Specialty sands such as silica sands can command premium prices. Even aggregates for use in construction quality can vary with size and quality. The consequent price can vary from $5.38 per tonne (for ungraded 3" surge rock) to $8.50 (for washed and graded gravel). Price will also vary with the intensity of demand.

Discussion with Statistics Canada have suggested an average price of $5.64 per tonne is a reasonable value representing the average price in Nova Scotia for sand in 1987. If this price is applied to the volume estimated above, then this portion of the site, *over its extractive life,* would have generated revenues of nearly $8.3 million *at 1987 prices.*

Even if these figures for price are reduced to the minimum of $5.38, the revenue would be some $7.9 million. If all the gravel sold were sold at the top of the price range, the revenue earned would be some $12.5 million.

It is also useful to try and put the rehabilitation costs into the context of the returns to capital. Statistics Canada also provide survey information on the costs, labour, fuel, materials and supplies for several Nova Scotia quarry and sand pit operators. These figures may slightly overestimate costs as they will contain an above average element of costs (as they include more costly silica sand production), but they can be used to estimate the costs of all operators sand, gravel and crushed stone operations in Nova Scotia.

After labour costs, fuel and material costs are deducted, the lifetime net revenue generated by the site available for interest, profit and rent would amount to over $1.4 million. The rehabilitation costs of some $71,000 would represent 5% of this net revenue figure.

Table 4.2 summarizes these figures.

Table 4.2
Revenue, Output and Costs of Rehabilitation for Example One

	Total	*Per Hectare*
Estimated Total Lifetime Output on eight hectares (Tonnes)	1,727,520	215,900
Net Yield (after 15% loss for fines)	1,468,392	183,549
Estimated Gross Revenue		
$5.38/tonne§	$ 7,899,949	$ 987,494
$5.64/tonne¶	$ 8,281,730	$1,035,216
$8.50/tonne‡	$12,481,332	$1,560,167
Operating Costs	$ 6,857,390	$ 857,174
Estimated Net Revenue *(after)* labour, fuel, materials, *before* rent, depreciation, interest at 1987 prices)†	$1,424,340	$ 178,042
Cost of rehabilitation (1988 cost estimates)	$ 70,999	$ 8,875
Value of a levy (at 8 cents/tonne, 15% loss per fines)	$ 117,500	$ 14,688

§ Current minimum Halifax price (at quarry) of lowest grade 3" surge rock.
¶ Statistics Canada Average Nova Scotia 1987 price for sand and gravel.
‡ Upper limit of current Halifax price range washed and graded gravel
† Derived by: (Price-materials-fuel-wages-supplies) - (shipments-change in inventories)

Sources: Statistics Canada "Quarries and Sand Pits", Tables 1 and 4 and personal communication. Terry Newman, Statistical Supervisor, Energy Mines and Resources Canada, Resources Branch, Information Systems.

Example Two: Ontario Progressive Rehabilitation Costs of a Four Hectare Section of Site to Grass

This example is based on the rehabilitation to pasture of four hectares of a gravel pit in Ontario.

In this instance the site required no hauling of soil materials because of proper planning and location of the stored soil materials. However, the site did require ripping to counter the effects of compaction of the pit floor which would impede drainage.

The site also required more conditioning of the soil than example one to make it suitable for cultivation. This should not be confused with the soil enhancement of Example One, which was necessary to supplement the *volume* of topsoil.

In Example Two, the topsoil, possibly as a result of poor storage or careless removal, had a high level of roots and stones which would hinder agricultural use and which were removed.

The tasks that were performed were:

- Levelling and Grading
- Ripping a Compacted Floor
- Spreading Soil Materials
- Harrowing and Rock Picking
- Harrowing and Removing Roots
- Fertilizing and Seeding

Table 4.3
The Costs of Progressive Rehabilitation of Four Hectare Sand Pit

	Per Hectare	*Total*
Grading and Recovering Costs	$2,945	$11,780
Cultivation Costs	$ 655	$ 2,622
All Costs	$3,600	$14,402

Sources: "The Cost of Rehabilitating to Agriculture" Peter M. Robinson, TCG Materials Ltd.
Nova Scotia Department of Agriculture Farm Management Fact Sheet" Average Costs of Grass Hay Production.
Nova Scotia Road Builders Association.
Gardner Pinfold Consulting Economists Limited.

Comparing the Two Ontario Examples

It will be noted that the costs per hectare are considerably lower in the second example as a result mainly of the lower soil haulage costs. On this second site the soil materials removed to reach the aggregate deposits were stored close to the working face so haulage was eliminated and the soils could be spread using only a bulldozer. This eliminates particularly expensive loading and hauling operations. This is only possible with progressive rehabilitation.

This reduced the costs per hectare by $5,280. There was little difference in the actual grading costs per hectare between the two sites, $3,115[4] in the case of Example One compared with $2,945 in the case of Example Two. This difference is well within the degree of error expected in these figures. The important point is the effect of haulage of soil and the importance of minimizing this by planning.

These two examples represent rehabilitation at a relatively intensive standard. They both relate to sand and gravel operations where because regrading and sloping are relatively easy and feasible using a cut and fill technique that

4 This figure is included in the total Grading and Recovering Cost of $8,223 shown in Table 4.1.

removes material from the top of a face and transfers it to the bottom, operators are required to carry out this regrading. However, cut and fill techniques are less feasible in a quarry where extensive regrading would require blasting and would be very costly. Much depends on the specific nature of each site but unless fill is available in quantity, deep quarries will not be able to backfill economically. This, however, is often treated by making a lake of the site and using a stepped or ridged backfill that provides for a gradual slope extending from the edge of the excavation to just below the water level.

Financing

Under a rehabilitation procedure similar to that operated in Ontario, most of the costs of rehabilitation would be eligible for recovery from proceeds of the levy paid on production. These costs would be eligible up to the amount of those proceeds.

All costs except the cost of hauling soils would be repaid in full to the pit operator. In the case of the costs of hauling soils these are repaid to the level of fifty percent. The rationale for this is that half this cost is regarded as a cost of extraction not of rehabilitation. Some operations use plans which allow for moving all soil only once. They have no costs associated with rehabilitation and can recover their deposit almost immediately.

A further point of note in the Ontario system is that operators are able to use their own equipment and charge the cost at an agreed rate to the cost of rehabilitation and recover this from their levy credits. The rate agreed is based on market rates for the equipment, but in so far as operators are able to use otherwise idle equipment at a cost below the agreed rate, they can earn a partial rebate of their levy by using the equipment.

Example Three: Nova Scotia, Milford Shale Pit[5]

The Milford Shale Pit is approximately four hectares (ten acres) in size, of which two hectares (five acres) have been rehabilitated. The pit has been utilized for more than fifty years by L. E. Shaw Limited as a source of raw material for its brick manufacturing plant.

In 1979, a rehabilitation plan was drawn up for this pit. It showed the location of remaining reserves, proposed time frame for extraction, extent of extraction, and planned progressive rehabilitation of the site. As land was purchased for pit expansion, a guarantee to rehabilitate the site was included in all sales agreements.

In the summer of 1982, 0.4 hectares of the site was rehabilitated. Rehabilitation included the establishment of a small pond (approximately .12 hectares), grading of the area immediately surrounding the pond and planting of legumes.

In the fall of 1982, a row of one metre high White Spruce was planted between the residential properties and the working pit. These trees are now about three metres in height.

In 1983, Honeysuckle bushes were planted by the small pond.

In the summer of 1984, Phase I of the rehabilitation plan was completed. This involved moving in excess of 30,000 tonnes of overburden to back fill a 92 metres long, 12 metres high section of the southern face of the pit. This was achieved through the use of the company's bulldozer over a two week period of time. Once the operator completed back-dragging, the resulting slope was hand-sewn with highway mix at the rate of 112 kg/hectare, and fertilized with 17-17-17 at the rate of 307 kg/hectare.

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5 Source: Nova Scotia Sand and Gravel
Robert Parker Associates Ltd.

In the summer of 1987, Phase II of the rehabilitation plan was completed. One hundred and thirty eight metres along the western face of the pit was back filled. This face was immediately adjacent to the residential properties, and approached 15 metres in height along some sections. To achieve the desired slope required moving more than 70,000 tonnes of overburden from another area of the pit. To complete the moving of this material, a 980 Caterpillar loader, 2-DJB off-road haulers, and a small track loader worked for four weeks. Once the material was in place, a track loader worked for another week, fine grading the area to an acceptable slope. A local farmer was then hired to disc, harrow, seed and fertilize the area. Fertilization was set at 505 kg/hectare of 12-24-24, and highway mix was sewn at the rate of 112 kg/hectare.

The end result is a 2.0 hectare field, sloping to a .12 hectare pond. To date, the total cost of rehabilitation is $78,150[6]. The cost per hectare is $39,075. See Table A5.4 in Appendix Five for details.

All vegetation is well established and the entire area is stable and aesthetically pleasing. Children now use the site for a safe tobogganing and skating area in the winter. During the summer months, the pond is utilized by waterfowl.

4.3 Policy Instruments Available to Achieve Rehabilitation[7]

4.3.1 Introduction

This section discusses the various instruments available to policy-makers to achieve rehabilitation, the advantages and disadvantages attached to each. The discussion is in general terms and not Nova Scotia specific. It is meant to lead to some conclusions about the optimal set of regulatory instruments.

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6 Excluding the cost of a rehabilitation plan which could add a further $10-15,000.

7 Policy instruments refers to the use of fiscal devices (e.g., taxation, leins) and administrative controls (e.g., zoning licencing) to achieve rehabilitation. Even-waging rehabilitation through education is dealt with in the Recommendations.

The Multiplicity of Objectives

Policy-makers will have several objectives concerning the pits and quarries industry. These will include:

- the economic health of the industry;
- the implications it has for the use and re-use of land and;
- the external costs (including the devaluation of adjacent land) it imposes on others[8].

In order to achieve as many of these objectives as possible it is necessary for policy-makers to have as many policy-instruments as possible.

The Available Instruments

There are two basic types of policy instruments available to authorities to achieve their objectives:

- Administrative or licensing controls, that specify whether, where and under what conditions, the extraction activities responsible for the external costs may be conducted; and,
- Financial or fiscal devices which seek to ensure that there is a financial deterrent applied to the producer that varies with the production of the external costs. These funds can be used to finance both compensation for those who suffer from the activity, and to provide remedy e.g. by some minimal level of restoration of the land after extraction has ceased.

4.3.2 *Administrative Controls*

Zoning

Instruments such as zoning controls can be used to achieve land use objectives. They can prohibit or permit operations in certain locations. They can

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8 External costs refers to costs incurred by nearby property owners affected by pit and quarry operations.

offer absolute protection to specific sites and communities that are judged to be particularly sensitive to the land use or external costs. This avoids the imposition of external costs on such communities but at the cost, to the wider community, of losing the economic benefits to be derived from the exploitation of the resource.

Zoning controls that simply grant a permit without imposing any conditions on quarrying operations or restoration of the land after the permit is granted, have no effect on the level of external costs imposed by the operation or on the condition of the site after the operation has ceased. Once a license is granted there is no control of external costs or of the condition of the site after use.

Conditional License

By making the retention of the license conditional on some milestones of performance related to the manner of operation and the rehabilitation of the land, and by monitoring this performance, some control of the quarrying operation may be achieved. This requires at least some minimal degree of agreement on the re-use of the land and some provision of resources for monitoring operator behaviour.

Short Term Licenses Can Hamper Long Term Rehabilitation

The effectiveness of a conditional license varies with the quality of the enforcement and the length of time for which license is granted. The shorter the period of time for which the license is granted, the shorter any interval of non-compliance. Unfortunately, the shorter this period of time, the more frequent the inspections and the more costly the administration of the scheme.

A second disadvantage of short term licenses is that they may hamper the industry in its planning and investment. By emphasizing short-term operations, they may undermine the attainment of the objectives of responsible operation and long-term rehabilitation.

Figure 4.1: Policy Instruments for Pits and Quarries Rehabilitation

Administrative Controls

- Zoning
- Licensing
  - Conditional
  - Short Term
  - Long Term

Fiscal Device

- Lump Sum Payments
- Levies on Tonnage or Revenue

Prepared by Gardner Pinfold Consulting Economists Limited.

Long Life Operations Require Flexibility of Re-Use But Weaken Control

Some forms of license require the proposed end use for a site to be specified. As quarrying may occur over a decade or more and external circumstances will change, the optimal reuse of the site may change. If alterations to the original condition of a licence is to be permitted in response, then there is a danger that such alterations will be sought merely as a device to avoid rehabilitation. If such alterations are to be permitted easily, then such a conditional license is liable to lose credibility as a means of enforcing performance and controlling external costs. The original declared intent which earned a license will bear no relation to the final state of the site.

At the same time it is still necessary to have some means of allowing flexibility regarding the end use of the site. The crucial factor would seem to be that some test be applied before granting the change, a test such as ensuring that the standard of rehabilitation is not reduced.

4.3.3 Financial Controls

Fiscal or financial controls can be of two kinds, lump sum deposits held as security for compliance or deposits raised from levies on output or revenue.

Both require funds be paid to the licensing authority to be held until some minimum level of rehabilitation has been accomplished. The amount of the deposit is usually tied to the land area of the site or some estimate of the volume of material to be removed. Deposits are returned to the operator when evidence of the expenditure by the operator on rehabilitation is presented. The rehabilitation expenditures claimed by the operator are usually equal to the amount of the deposit held by the licensing authority.

The differences between the two are likely to be in their effects on the cash flows of the operator. Where the expected volume of extracted material is large a levy would impose less of a burden on the operators finances. Lump sum deposits, unless used only where the volume is small, would have an impact on cash reserves particularly in the case of small operators.

An Average Security Deposit Ignores Variation in Rehabilitation Costs

There are a number of difficulties with such an approach. For reasons of equity, the level of any deposit is set at some average amount applied to all sites and is not related to the rehabilitation needs of each site. Experience in Ontario suggests that costs of rehabilitation vary widely particularly in response to the depth of excavation at a site. A standard cash deposit per hectare or per tonne cannot accommodate such variation in costs. In general the deposits have proved to be inadequate to fund the desired levels of rehabilitation at deep sites where the costs of backfilling and re-contouring the excavation are extremely high.

No Impact on Choice of Re-Use

The rehabilitation deposit system has no impact on the re-use to which the site is put. This is a major drawback if the land use is a major element of policy concern.

A Fixed Levy per Tonne

Levies in the form of a fixed fee per tonne are directly related to the output of the operation. As a means of restricting external costs this relies on the assumption that at least some of the external costs imposed on the society are directly related to the tonnage of output. However, as long as the levy per tonne is relatively low, is a small element in the operators cost structure, and the operator is willing to pay it or pass it on to customers, it offers little control of the external costs imposed.

Levy Not Related to Rehabilitation Costs

An averaging levy is not necessarily related to the rehabilitation needs of the site. Furthermore, an average does not convey to operators the sensitivity of rehabilitation costs to their technique of operation. Any levy that treats each tonne extracted as having equal consequences for the rehabilitation and re-use of the site, i.e., any levy fixed per tonne or as a percentage of a average price, will not accurately reflect marginal increments in the costs of rehabilitation occasioned by increments of extraction. Such a system of levy therefore is not an effective device for guiding the operator towards a manner of operation that will minimize the costs of rehabilitating the particular site. The incremental funds raised by a levy, fixed per tonne, will not be related to the incremental costs required to remedy the effects of this marginal extraction. In fact, as quarries get deeper, even the entire incremental revenue earned by such incremental extraction would be unlikely to cover the incremental costs of rehabilitation.

Post-Extraction Rehabilitation Often Compromised by Operations

In addition operators may not pay very much notice to a relatively distant (for the operator) need for rehabilitation of the site. In times of strong demand for the product, the temptation to maximize output while prices are rising is powerful. Such a short-term expansion of output may affect the potential for the re-use and rehabilitation of the site to an extent that is reversible only at high cost.

A Levy on Revenue

A charge levied on the value of output does have the advantage of keeping up with the price level but again it is not related to the incremental cost of reversing the additional damage done to the potential re-use and rehabilitation of the land by any incremental extraction. It does not influence the operators positively towards planning for the re-use of the site. It has the appearance of a tax unrelated to rehabilitation.

A Maximum Levy

Imposing a maximum on the amount of levy per acre that the operator need pay towards the cost of any rehabilitation, can result in further divergence between the cost of the necessary rehabilitation and the sum available. This is particularly the case where excavation significantly lowers the pit floor and backfill costs can become extremely high.

Imposing such a maximum on the amount of the levy per acre has one beneficial effect in that it reduces one area of uncertainty facing a prospective operator regarding the cost of rehabilitation of a potential quarry. However, this benefit is achieved at the cost of reducing the efficacy of the levy as a tool of rehabilitation.

There are other ways of reducing this uncertainty without sacrificing the incentive to rehabilitate, most notably by agreeing on a rehabilitation plan before quarrying operations commence and by agreeing on a detailed costing of such a plan in regard to the operation and output of the quarry.

A Minimum Levy

A minimum levy may result in situations where the operator who extracts small amounts (i.e., amounts which, by the levy alone, would not have raised this minimum sum) from a site suffers a disproportionate levy in comparison with operators of larger sites. At a small site the operator who had to pay a minimum levy per hectare would end up having to pay a higher levy per tonne or a higher percentage of his revenues than his competitors. This could induce such an operator to reduce operations at small sites and expand operations at large sites incurring greater transport costs. In any event the degree of discrimination and dislocation is likely to be small and may be partially remedied by varying the minimum in accordance with the size of site.

A Summary of the Limitations of these Instruments

With a combination of licensing and levy (or deposit) the operator essentially is licensed to produce an unrestricted amount of material and external costs in return for paying a levy per tonne of material (up to some maximum).

The operator has little incentive to live up to his commitment to rehabilitate unless:

- the deposit is relatively large and worth recovering, which would affect the price the consumer pays; or
- the operator wishes to obtain a new license to operate. As the operating life of a quarry or pit can be measured in decades, a small operator with large reserves may have little desire to open a new site and little consequent incentive to rehabilitate.

Both regulatory and financial instruments as typically used, suffer from the disadvantage that they do not influence the extraction activities of operators with the intent of minimizing the rehabilitation required after extraction. This is a significant disadvantage as the cost of any rehabilitation necessary to return the land to another productive use, can be critically affected by decisions taken prior to and during the process of extraction.

There is no guarantee that the funds accumulated by a levy or raised by security deposit will be sufficient to cover the cost of the required rehabilitation.

Neither the licensing system nor the security deposit affect the nature of the re-use to which the site is put. The re-use chosen will not necessarily be an optimal one; the selection is most likely to be governed by a desire to minimize costs of rehabilitation rather than optimizing land use within the constraints of rehabilitation costs.

4.3.4 The Progressive Rehabilitation and Re-Use of Land

Setting aside extensive areas for pits and quarries involves an opportunity cost in that the land being used for extraction can have other valuable uses. As has been pointed out above extractive operations often occur close to areas of development and rising land values. It is possibly in the quarry operators own interest therefore to realize some of that potential value either by progressive or simultaneous re-use of those parts of the site not in actual use for quarrying and by adopting practices in the process of extraction which will allow the most speedy and economical return of the site to one of those other valuable uses. The extraction process can be seen as one which offers the landowner, as a by-product of extraction, the additional opportunity to reshape the land. This might well be done at a cost much lower than would be the case if the heavy machinery were not already on site and the soil and subsoil removed.

However, the experience of other jurisdictions suggests that rehabilitation itself has little effect on the value of the site. Where a site appreciates in value and invites development this is a consequence of urban growth and not of rehabilitation[9].

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9 In other words, the market judges rehabilitated land to be more valuable because it can be allocated to a new, higher value use.

Rehabilitation may reduce the costs of development by reducing the costs of regrading and other development costs but these have been marginal factors in the land use decisions elsewhere.

Rehabilitation does, however, have a significant effect on the value of neighbouring properties. Even in the absence of development, owners of such properties have enjoyed capital appreciation gains. These may be seen as compensation for any external costs or inconveniences incurred during the extraction process, such as coping with noise and air pollution.

The Choice of Re-Use

There will have to be minimum standards for re-use if a situation is to be avoided where numerous operators simply title an abandoned quarry a 'nature reserve' or an 'aggregate reserve' merely as device to spend nothing on it, or where a region has numerous derelict sites all thinly disguised as A.T.V. parks. Individually these are legitimate land uses, but a region has a need for only so many of them. The market for land rental or sale may be able to take some account of this (by lowering rents), but the level of rent set by the market does not take account of the costs of rehabilitating a particular quarry site. The planning or zoning authority may be the appropriate one to control this and it will be necessary for this body to liaise closely with the licensing body. The aim of the authorities must be that the re-use is chosen not because it avoids costs for the operator but because there is an effective demand for that land use.

Minimum Standards of Rehabilitation

There will be cases where an operation removes only a small amount of material and the security deposit raised, based on a per/hectare disturbed land formula, does not cover a minimum rehabilitation. In such a situation it will be necessary to use minimum standards of rehabilitation. These standards should ensure that the land is returned to a sympathetic form with that of the surrounding landscape, that the land is ecologically productive and that any safety hazards are removed.

Expertise

At present there is a lack of information among operators about the possibilities for land re-uses. There is also a particular lack of knowledge about those techniques of planning and operating quarries and pits that serve to reduce the costs of achieving a speedy and profitable re-use of the land. These deficiencies are impeding the profitable re-use of land and in particular the progressive re-use. It is necessary to inform the operator about the operating practices that will avoid the need for high cost rehabilitation. This could well occur as a part of the licensing process. Operators could be required to inform themselves to some minimum standard, of the techniques for optimal operation, and the licensing process could involve the joint co-operative design of a detailed plan covering operations and rehabilitation before the start of a quarrying operation.

Operational and Re-Use Planning as a Policy Instrument

Operators equipped with a knowledge about these techniques will be able to plan their operations in such a way as to maximize their returns both during and after extraction when the entire site becomes available for re-use. The regulatory authorities may insist as a condition of license that operators adopt certain techniques in both their plan of operation and in the plan for the re-use or rehabilitation of the site. A further step would be to adopt a levy, the level of which and any repayment of which, was tailored to these plans and to the operators compliance with them.

If such an approach is adopted then policy makers will have a range of instruments which, used in combination, will offer flexibility and discretion in achieving their objectives.

Operators will have the security of knowing that what was required of them was clearly specified and not subject to arbitrary change, that all their competitors in the same market were subject to the same terms, and that their activity would be protected while they complied with the agreed plan.

Local communities would have the assurance that the extractive site would not be abandoned leaving them with devalued properties, that there would be progressive improvement of the site and that the external costs would be abated.

4.3.5 Optimal Regulation

The aggregate industry is both a contributor to the economic welfare of the society and a contributor of undesirable effects. The system of rehabilitation should recognize the value of the resources both to local economies and to the wider interests of the community, and protect these resources for future use. It must also recognize that the industry inflicts external costs on local communities and the wider society and seek to minimize these, to compensate for them and to ensure they are temporary.

It is clear from the above that there is no single instrument that will meet all the required objectives. Several will be required. This is especially true if the objectives are liable to change in importance over time, for example as the resources become depleted and scarcer, if unemployment rises in a locality, if a locality becomes developed, if export markets grow.

The desirable characteristics of optional regulation are summarized in Figure 4.2. Whatever the range of instruments developed, there are several elements that will be essential.

- Ensure that information on the best practice of rehabilitation is made available to quarry operators, to rehabilitation inspectors and to the public.

There is a pressing need to equip the operator with technical information about the optimal way of operating with a view to rehabilitation e.g., storage methods for topsoil, optimal contouring for a specific, agreed end re-use. It is important that the inspectors who oversee the rehabilitation share the same information. Providing the same information to the general public or local communities will ensure that those with the greatest interest in seeing rehabilitation performed will be equipped to judged the rehabilitation being conducted.

- An effective system will have effective enforcement of the rehabilitation required.

Enforcement will require inspection and incentive. Inspection will require a team of inspectors who are aware of the state of rehabilitation at each site. The incentive will require a means to persuade operators to comply with the standard. The possible loss of a security deposit may not achieve this, depending on the size of the deposit.

The security deposit is really a means of ensuring that funds are set aside for rehabilitation. It will not prevent an operator abandoning a pit where the cost of rehabilitation would exceed the deposit.

In some regions, where demand for aggregate is growing fast, restricting access to new deposits unless rehabilitation is carried out, may be effective. Where operators are less eager to open new sites other incentives may be needed. One such is the suspension of the extraction license.

- An effective system will have uniformity of standards for all operators.

This is absolutely essential if the system is to have a chance of being accepted by operators. Any system that is to be successful in the long term will have to obtain this acceptance.

Uniformity, however, can be defined in a number of ways. For example, it has been argued that a rehabilitation levy should be a *uniform percentage* of an operators revenue. (This particular example is difficult to support. Other costs, diesel fuel or equipment spare parts, do not vary in this way. Applied in such a way the levy becomes a sales tax.)

The important principle is that the objective is to restore the damage done by extraction. The levy is intended to restore the site and should be related to the damage done. The volume of material is an adequate proxy for this.

An ideal system would seek to match closely the funds raised at each site to the costs required to rehabilitate that site and restore it to some productive use. However, it is difficult at the introduction of an unfamiliar system, to find support for a system that would require the levy to vary according to the type of site or the difficulty of the rehabilitation. This leaves the sole option of varying the levy directly with output.

- An effective system will require consistency over time in the treatment of each operator. One element of this will be a plan for rehabilitation, prepared at the start of the process, and agreed and accepted by the operator and the inspector.

To do otherwise would be to invalidate the initial rehabilitation planning which is the cornerstone of any system. It will lose operator acceptance, will cost more than necessary and hamper rehabilitation.

There must be some capacity for flexibility built into the system to enable each side, the licensing authority and the operator, to seek variations in the initial plan, but this should be subject to limitations and appeal. Nor does this preclude consistency of administration.

- Any requirement for rehabilitation, if it is to affect the competitive position of all equally, will have to apply to all sites, existing as well as new sites.

This is crucial. Without such a provision, existing (exempt) sites will be granted a competitive advantage over newer sites where planned rehabilitation is practised. Consequently, the extractive life of such sites will be prolonged to the detriment of their neighboring communities.

- Require progressive rehabilitation as the most effective means of achieving the rehabilitation of the site.

Progressive rehabilitation is certainly most cost effective and even offers the potential for reducing the costs of the extraction process for operators. It offers the greatest scope for the earliest reduction of external costs caused by extraction and the earliest restoration of the site. It should be required of operators.

- Licensed extraction operations should be protected from zoning changes that seek to curtail the extraction.

It is clear from the experience of other jurisdictions that rehabilitation is carried out by operators in return for some assurance of security of operation. If this is denied, then operators interest in rehabilitation will be severely diminished. Land use conflicts will probably occur and recur during the extractive life of a site. Different interests may seek to prevent extraction from occurring, seek to end existing extraction operations and alter the zoned reuse of sites. If this happens, operators who have agreed to and commenced the implementation of a rehabilitation plan, will have an incentive to minimize their efforts at rehabilitation. Avoiding this requires that extraction be recognized as a land use and that the resource be protected in an orderly and consistent manner.

- There should be minimum standards of rehabilitation and a minimum deposit.

It is quite possible that cases will arise where the volume extracted and the amount of deposit raised by a levy would not cover the cost of rehabilitation of the site. In such cases it would be necessary to apply minimum standards of rehabilitation to ensure that the site is not abandoned. This would require some minimum deposit be paid in a lump sum.

- There should be no maximum level of accumulated deposit.

The argument in support of a maximum is that it provides operators with an assurance that their rehabilitation costs will not exceed a certain level. However, the primary purpose of the system is to rehabilitate the site. The rehabilitation needs will be directly related to the volume of material extracted. The funds set aside for rehabilitation should follow the same principle. To set a ceiling on the levy per hectare would be to encourage intensive extraction and result in intensive damage beyond the scope of the funds raised to remedy. The costs of opening new sites already provide operators with an incentive for intensive extraction at existing sites.

The rehabilitation plan designed by the operator in conjunction with the licensing authority should provide sufficient assurance as to what is required of the operator.

The evidence of other jurisdictions where operators spend well in excess of the proceeds of the levy diminish the force of the argument for a maximum.

5.0 A GUIDE TO REHABILITATION PRACTICES

This chapter is an outline, or model, for a future booklet entitled "A Guide to Rehabilitation Practices for Nova Scotia". A few of the operators in the Nova Scotia extraction industry already practice progressive rehabilitation. To these operators the message of this "booklet" may seem obvious. The primary purpose is to provide a starting point for new operators faced with the possibility of new regulations. The "message" is simple: progressive rehabilitation does not cost, it pays.

5.1 Why Rehabilitate?

The extraction of minerals is a necessary process. Almost all construction materials and consumer products from glass to toothpaste are made from extracted materials.

Both the land and the materials extracted from the land are non-renewable resources. Extraction is, therefore, a temporary, or interim, use of the land in competition with dozens of other possible uses. In the long term, rehabilitation is not a question of why? or if? but rather of when and how.

As William Coates stated in his address at Michigan State University in 1982:

> "All mining lands should be rehabilitated. Any area which can be mined can be rehabilitated to a condition consistent with local context. If society requires the minerals below the surface of the earth, then it must be prepared to pay the full price of having them. This full price includes the cost of re-establishing long term surface productivity, the cost of healing a wound on the surface of spaceship earth."

A pit or quarry does not need to represent a loss of useful land to the community. Once the valuable material has been extracted the land should be returned to its original use or to an alternative productive after use.

Environmental protection is another obvious and significant reason for the progressive rehabilitation of the land. Political and social climates have changed. The public has a heightened awareness of the biological requirements for clean air, water and soil, as well increased expectations about the elimination of visual

pollution. Wise environmental management of the land minimizes erosion, facilitates natural drainage cycles, reduces or eliminates toxicity, and promotes safety through the elimination of site hazards.

Aesthetic concern for the landscape recognizes inherent values associated with the beauty of a landscape in its natural state for both local residents and for the growing tourism industry. This means requirements for preservation of the rural landscapes will also increase.

The image of the industry also dictates an increasing requirement for rehabilitation. Good rehabilitation will make continued operations easier. Rehabilitation is recognized as an important trend in good corporate citizenship.

One last important reason to plan for progressive rehabilitation. **It can pay. When planned properly, progressive rehabilitation saves money.** And, rehabilitated land, because its potential for re-use is expanded, is frequently worth more money. In contrast, rehabilitation of land at the end of the extraction process can be costly in terms of both cash and time. Rehabilitation yields economic benefits for everyone including the operator, the local community, government, and society.

5.2 What is Rehabilitation?

Progressive rehabilitation is more than just rehabilitation of the land. It is also much more than just making the site "invisible".

Rehabilitation is not a last minute activity designed to "zip up" a site. "Last minute" rehabilitation activities result in no benefit during the life of the operation. They are paid for while receiving the lowest income from the site. The "dig now and worry later" concept associated with rehabilitation is full of false economies.

Progressive rehabilitation is on going during the life of extraction. To do this requires a plan. A good rehabilitation plan will:

- complement the extraction or operating plan
- fit final land form to the next intended use
- create a soil profile which will not limit use
- return usable, valuable land sooner

- reduce "public relation" problems related to operations
- end the unnecessary movement of extracted material
- end multiple movements of topsoil and overburden
- optimize use of expensive equipment
- optimize exploitation of the resource
- increase resale land values
- SAVE MONEY

Progressive rehabilitation is part of a comprehensive operating plan and begins at the commencement of operations.

5.3 How Do I Plan for Progressive Rehabilitation?

There are three things you must do to adopt the progressive rehabilitation approach:

1. Commitment

2. Collect adequate site information for planning.

3. Create a comprehensive operations plan including extraction, progressive rehabilitation and end use for the land.

Step 1 - Commitment

Commitment comes not only with the recognition of the importance of progressive rehabilitation but also with action necessary to implement progressive rehabilitation, steps 2 & 3.

Step 2 - Collection of information

This step is slightly more difficult. A shortcoming in the preparation of many operation plans is the lack of correct information on the extent and quality of the resource. Bad information may require a significant change in operating plans halfway through the extraction process.

A second problem in data collection is in not considering adjacent land uses and resource deposits in enough detail. The plan and the base data must cover an area much larger than the extraction site.

The better the data on which this plan is based, the better the plan.

At a minimum you will need information on:

- resource - limits and quality
- drainage - both surface and ground water movement
- overburden - type and depth
- geology - bedrock and surficial
- climate - micro and macro
- vegetation - existing and native plants
- planning - surrounding land uses, municipal planning strategies, zoning, and other land use controls
- community concerns for after-use
- end use - type and potential demand

Step 3 - Create a comprehensive operations plan

The operations plan shows:

- known and assumed reserves,
- methods of extraction,
- wash and settling pond areas,
- dump locations,
- final profiles of the land,
- sequential areas for movement of topsoil,
- overburden,
- materials storage sites,
- planting areas,
- processing areas,
- operations schedule,
- equipment requirements,
- the sequence of extraction activity,
- the timing of planned extraction activity,
- etc.

Often the most difficult part of preparing any rehabilitation plan is deciding what the best end use is to be. If the site is in the centre of a City, the decision may be easy. As the site becomes more isolated the end use, or after use, becomes harder to determine.

Selecting the end use, or after use, is one key to preparing the most cost effective operations plan. If you have a final configuration in mind, it is easy to

shape the land for best advantage. You can think of the extraction process as a way to generate revenue while creating the perfect site for the intended use. Think of the resale or development of the land as your primary goal. Think of the extraction process as a cost effective way of realizing this goal.

To determine the best after use for your land you need to consider the following items:

- The Characteristics of your proposed pit or quarry.
- Features such as the depth of overburden, the depth of the planned resource excavation, the depth of the groundwater, topography, and soil type.
- Surrounding Land Use Patterns and The General Land Use in the Area (Is the site close to town? Is it in the centre of an agricultural area?)
- Municipal Zoning.

If the end use is obvious, the preparation of the operations plan will flow smoothly and will clearly articulate the tasks required for progressive rehabilitation. As the end use becomes more vague, the plan then becomes more general. The problem of selecting an appropriate end use is usually solvable.

Mid to long term operators may need to include an evaluation of proposed uses every few years as a part of the operations plan. External factors can change including the interest of the operator in any given end-use.

The following is a short list of typical end uses. This list is meant to start the thinking process and to show the variety of possibilities.

Preliminary list of After Uses:

Agriculture:

- Crop land or pasture specific to site and soil
- Christmas tree plantation
- Orchard
- Aquaculture (fish farming)

Forestry

- Pulp production
- Fuel production

Recreation

- Gun clubs, rifle ranges
- Golf course
- Swimming area, park
- Fishing lake
- Residential lake
- Sports fields
- Motor sports, safety training, ATVs
- Botanical gardens

Housing:

- Urban or suburban, single family to high density
- Golf course residential area
- Lake front residential

Industrial:

- Industrial park
- Storage
- Auto salvage

Natural area:

- Conservation and interpretive area
- Game reserve

Sanitary Landfill:

- (Depends on specific site features)

Special:

- Academic research
- Municipal sewage treatment sites
- Reuse of sewage sludge for site rehabilitation
- Quarry development as tourist or recreation attraction

5.4 Preparing the Rehabilitation Plan

As a step-by-step process the preparation of rehabilitation plan looks like this:

Call the regulating authority

Ask for help. The inspector may be the best source of information available.

Plan the extraction work and rehabilitation work together

Start by determining the intended final use.

Determine the extraction and processing plan.

Review site assets and liabilities

a. Now
b. Future

Produce a combined operations plan

Considerations of the plan:

A. Timing
   1. Market
   2. Competition
   3. Construction
   4. Cash Flow
B. Equipment
C. Soil
D. Mineral
E. End use
F. Interim use
G. Routine responsibilities
H. Operator Interests
I. Regulations

"Tricks" which the plan may incorporate:

A. Never Sell Topsoil
B. Use Extraction Equipment for Rehabilitation
C. Clean Fill Credit for clean fill brought to your site[10]
D. Design End Use For Minimum Impact
E. Move Nothing "Twice"

Get required permits

Rehabilitation is not a cosmetic treatment of the land. Landforms created through progressive rehabilitation are functional as well as aesthetically pleasing. Landforms are designed to accommodate the proposed end use in the most cost effective way.

The notion of progressive rehabilitation also allows you to close the extraction/rehabilitation/re-use loop faster. This should translate into better economics for everyone.

The plan will reduce off site damage due to large stockpiles and will prevent the multiple movement of materials. When you are doing it right everything just gets moved once.

The plan will also minimize social costs such as road relocation and damage, noise, dust, removal of land from productive use and visual damage to the landscape.

The plan will address environmental matters such as ground water contamination and depletion, erosion, and alterations to microclimate.

The following two sections are simple examples of how progressive rehabilitation can simplify productive end use of the land. Appendix 7 provides an example of an actual rehabilitation plan.

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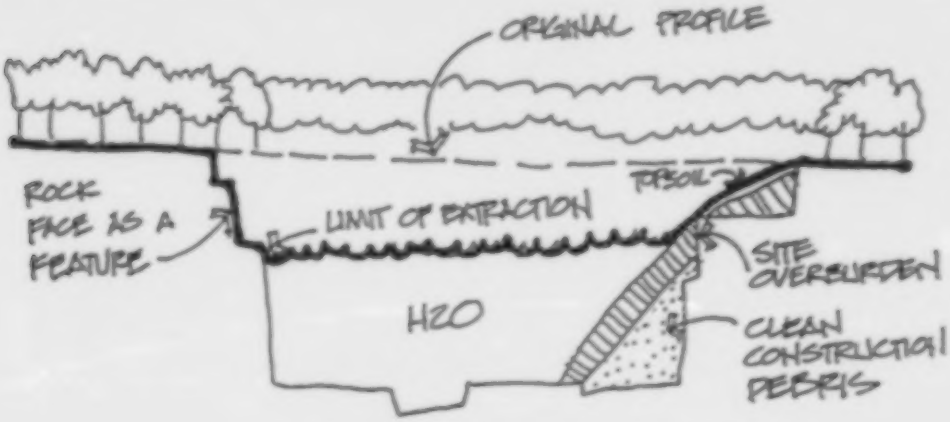
10 A clean fill credit is a payment made to truckers who deliver clean fill when they come to pick up a load of sand or gravel.

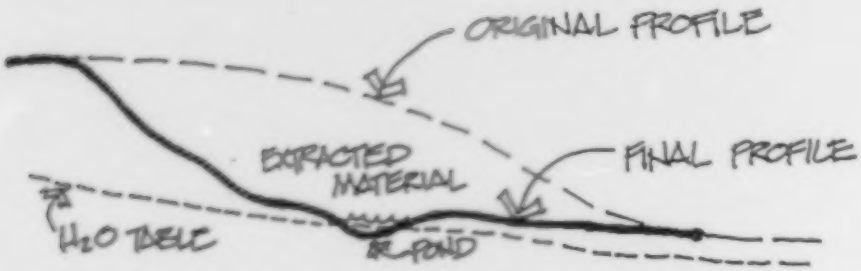
5.5 Example A - Deep Consolidated Materials Quarry as a Recreation Area (Not to Scale)



The Steed & Evans site near Burlington, Ontario, has been progressively rehabilitated since 1972 as a recreation lake.

Gardner Pinfold Consulting Economists Ltd.
in association with
Robert Parker Associates Ltd.
Peter Klynstra Landscape Architects Ltd.

5.6 Example B - Shallow Extraction as a Development Site (Not to Scale)



The Steed & Evans site west of Fonthill, Ontario, has been progressively rehabilitated since 1970 to a golf course.

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Robert Parker Associates Ltd.
Peter Klynstra Landscape Architects Ltd.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The required elements for any legislative and administrative system dealing with pit and quarry rehabilitation to be effective were discussed in Chapter Four. The main points can be reiterated as follows:

1. The system must exhibit uniformity of standards for all operators (including government departments such as the Department of Transportation and crown corporations such as SYSCO), treating all equally. This will also require any system to apply to all sites.

2. The system must provide for effective enforcement.

3. The system must be consistent over time to allow effective planning by operators.

4. The system should protect licensed extraction operations and should protect the availability of the resource.

5. The system must ensure that information on the best practice rehabilitation is made available to quarry operators, to rehabilitation inspectors and to the public.

6. The system should encourage progressive rehabilitation where possible.

The proposed legislative and procedural changes identified below are framed in this light. They are also based on a review of the industry, existing legislation and conversations with key individuals in both the private and public sector.

Their purpose is:

1. To protect the resources so that they can be exploited for the benefit of the Province;

2. To ensure some control and amelioration of the external costs associated with extraction; and,

3. To achieve consistent policies regarding land use and clear lines of responsibility and authority.

These objectives should be compatible. For the industry to be seen as a good neighbour is its best protection. There will inevitably be land use conflicts and the industry is particularly vulnerable in this regard. It is tied to the location of a deposit and is vulnerable to pressure from groups whose interest may be narrower than the provincial community as a whole. In so far as the industry is seen to be responsive to the interests and welfare of the wider community and mindful of the nuisance it may impose, the more likely it is to gain community support for its activities.

Provincial Land Use Policy

With this background, the consultant recommends:

1. All existing and potential aggregate and mineral resources continue to be inventoried and mapped by the Provincial Department of Mines and Energy. The resource base should be rated based on such criteria as scarcity, quality and location of resource.

2. The Planning Act be amended to include pits and quarries, surface mining and mining as a land use. Ownership of mineral resources under the jurisdiction of the present Mineral Resources Act should remain with the Province.

3. Provincial Land Use Policy and Bylaws be developed to govern land use planning for mineral resources, operation controls and rehabilitation (affected would be all minerals not covered in the Mineral Resources Act).

4. Municipal Planning Strategies should: include and protect existing operations; identify and protect, where feasible, potential resources; clearly define planning procedures for municipal development permits and/or re-zonings to operate new or expand old operation; identify controls for operation; establish criteria for the granting of permission for wayside pits and quarries without a plan amendment and to set criteria for rehabilitation and after uses based on Provincial Policy.

5. Municipal land use bylaws should include an Aggregate and Mineral Resource Zone, which should be consistent with the Provincial Mineral Resource Inventory (first recommendation).

6. Where there is the greatest danger of losing the resource to encroaching development, operators should be encouraged to mine the resources for a limited time period. This should be done with the use of temporary licenses that will set a time limit on the period of extraction and permit stockpiling elsewhere if necessary and require high standards of rehabilitation.

These will be the areas of the most immediate and possibly most acute land use conflicts. It would be extremely difficult to persuade municipalities, developers and homeowners to accept in a developing area the (possibly sudden) acquisition as a neighbor of an extraction site with an indefinite life. To do so would require all neighboring land and property owners to accept severe capital losses on these assets. In situations such as this the resources can only be exploited if there is some assurance that the extraction operation will be temporary and short-term. Unless this is done there will develop between developers and municipalities on the one side and extraction operations on the other, a race to control the land use. The aggregate inventory will become the first weapon in such a race. Instead of protecting the resources it will be used to prevent its use.

Mineral Resources

The consultant recommends the **Mineral Resources Act** be amended:

1. To require comprehensive rehabilitation and physical plans for mines and surface mines. These plans should identify progressive rehabilitation based on mining operation plans and where feasible, selected after use(s);

2. To recognize the need to mobilize a comprehensive land rehabilitation program for all surface mining operations;

3. To require a review of the proposed Mining Lease every year based on inspection of the operators compliance with the terms of the licence relating in particular to the rehabilitation conducted;

4. To provide for the removal or suspension of a Mining Lease at any time in the event of non compliance with its terms; and,

5. To require the rehabilitation of abandoned sites resulting from mineral exploration and development.

The consultant further recommends:

6. The Department of Mines and Energy develop a **Mineral Aggregate Act** to include those minerals identified in Section 2(K)(i-iii). This Act would:

   - Provide for the licensing of mineral aggregates with the participation of the municipal unit.
   - Establish a per tonne levy system with no maximum level of accumulated deposit.
   - Establish two security funds, one to ensure progressive rehabilitation and to recompense for any expenditures incurred resulting from the additional burden on municipal infrastructure; the second to provide for the rehabilitation of abandoned sites. These could be based on Bill 170 Ontario Act to revise several Acts related to Aggregate Resources.
   - Establish minimum standards for rehabilitation and a minimum rehabilitation deposit. (Should be at least a level which would support uses for which the land was capable of supporting prior to operation.)
   - Control and regulate operations on Crown land, in concert with the Department of Lands and Forests.
   - Control and regulate environmental impact on operations in concert with Department of Environment.
   - Require comprehensive rehabilitation plans as a condition of license. Plans should identify progressive rehabilitation based on pit or quarry plans and when feasible, selected after use(s). Notice

of these should be published on application for license. Plans would be on file with the Department of Mines and Energy and available to the public and updated yearly. Plans to rehabilitate to an after use should be compatible with long term uses permitted by Municipal Planning Strategy.

- Consider the various stages of surface mining operations, that is: the exploratory and reserve phase, short term, medium term, long term, end of term, and abandoned operations.

- Cover operators who provide material for road construction. Coordination and control would be done in cooperation with Department of Transportation and the affected Municipality.

- Include Gypsum operations within its terms even though gypsum is technically not an aggregate.

7. **The Petroleum Act** be amended to include minerals identified in Section 2(K)(iv-v) of the Mineral Resources Act.

8. The Department of Mines and Energy coordinate all activities covered within the proposed **Mineral Aggregate Act** so as to provide a single channel of communication for the operators.

9. The Nova Scotia Department of Mines and Energy staff a **surface mining rehabilitation division** with persons experienced in rehabilitation activity. This should be done at a level which will provide operators with specific and consistent guidelines and requirements detailing acceptable standards and practices of rehabilitation. This will require persons familiar with rehabilitation strategies, environmental planning, and design capabilities as well as backgrounds in mining and engineering in order that operators may utilize these resources on a day to day basis. A working partnership should develop between the industry and government.

10. The Province provide training for an inspection staff. In establishing rehabilitation practices, Nova Scotia is likely to experience, initially at least, a deficit of expertise. Trained individuals will be required to carry out inspections and enforcement as well as produce plans and advice for operators. In such a situation it is important to establish particularly at the outset, before

plans become concrete, consistency of treatment. This will also play an important role in ensuring operators acceptance of the provisions. Consistency in the training of these individuals will be necessary.

It should be noted that inconsistency of treatment of rehabilitation at different sites may offer to operators the temptation to minimize their rehabilitation costs. This may be done by exploiting any variations in the requirements of different inspectors, thus varying the rehabilitation and transferring costs between different sites. Should this occur public confidence in rehabilitation would be lost.

Regarding the dissemination of information pertaining to rehabilitation, the consultant recommends:

11. That the Province together with industry sponsor a conference/seminar on rehabilitation for the purpose of exposing operators and *the public* to the issues, strategies, techniques, and case examples associated with rehabilitation work *and illustrate the possibilities offered by rehabilitation*.

12. That the Province carry out several demonstration projects on rehabilitation. Proposed demonstration sites are described in Appendix 6.

13. That the "How To Do It" Handbook outlined in this study be disseminated through the industry and local government.

APPENDIX ONE

APPENDIX ONE

1. The Aggregate and Industrial Materials Industry In Nova Scotia

Providing an accurate picture of the industry is complicated by the fact that the statistical data available are not always comprehensive.

The Nova Scotia Department of Mines and Energy provide statistics based on a survey of some (currently) eighty producers of aggregates. This survey has been expanded in scope in recent years; in 1976 the survey covered four companies. Consequently data for different years are not always available on a consistent basis.

Much of the data published by Statistics Canada covered the output of only eleven producers in Nova Scotia in 1987 whose principal business was aggregate extraction. This affords valuable information on the costs of operation of these producers but it does not provide a comprehensive picture of the size of the industry.

Some of the data published by Statistics Canada does cover all producers of aggregate not just those principally engaged in this. However, these are not consistent with the data from Nova Scotia Mines and Energy.

In deriving information on the size of the industry, the consultant has relied on data from the Nova Scotia Department of Mines and Energy. For data on costs and the distribution of aggregate consumption by end use, the consultant has relied on Statistics Canada sources.

2. The Size of the Industry

Table A1.1 gives an indication of the production, output and employment in 1985 of both aggregate industry and the industrial materials. The data on the industrial materials industry includes only the extraction operations and not the processing of these materials. Thus, for example, limestone extraction is included but not the processing into cement.

Table A1.1
Structural and Industrial Materials in Nova Scotia in 1985/86§

Product	*No. of Sites*	*Output* (Tonnes '000)	*Output* ($ '000)	*Employment*
Total Industrial Materials	**22**	**7,678**	**91,037**	**840**
of which:				
Gypsum	7	5,903	41,523	455
Limestone	5	587	4,660	66
Total Aggregate Materials	**80**	**13,097**	**58,982**	**823**
of which:				
Sand and Gravel	63	7,641	31,863	563
Crushed Stone	17	5,456	27,118	260

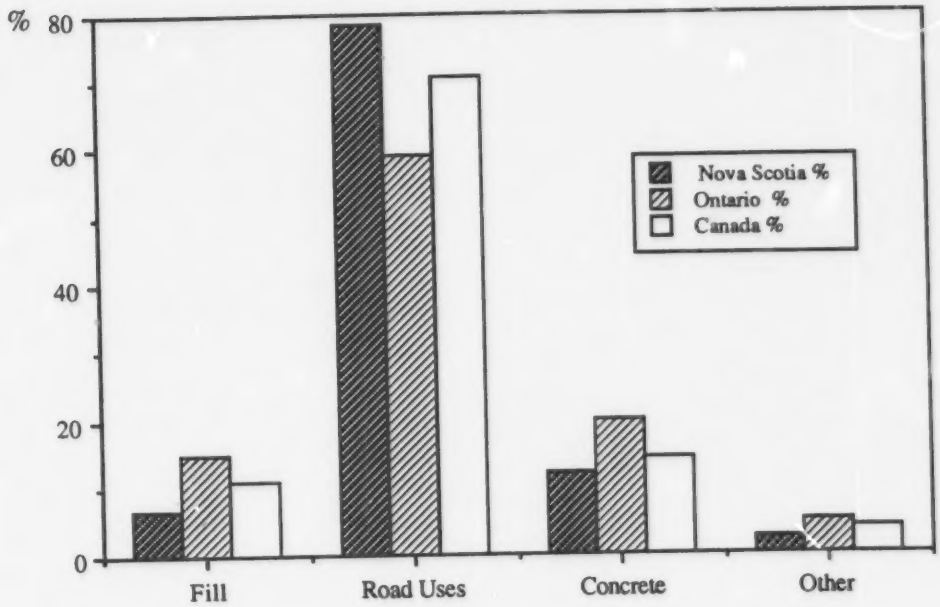
Source: N.S. Mines and Energy Annual Report 1985.

§ These figures cover operators whose principal business may not be extraction. They also include estimates of output and employment at non-reporting companies, that is, those operators most of whose output is supplied to the Nova Scotia Department of Transport.

3. The Consumption of Aggregates

Figure A1.1 below provides information on the relative importance of the various uses to which aggregates are put. The figure provides data for Nova Scotia and a comparison with all Canada and with Ontario.

Figure A1.1 Aggregate Consumption by Use 1987
Nova Scotia, Ontario and Canada



As can be seen the needs of road construction dominate use in all three regions, but it was particularly important in Nova Scotia in 1987. The impact of the recent construction boom in Ontario can be seen in the relative share of aggregate in concrete production.

The data relating to aggregate over time are unfortunately particularly susceptible to error.

The significance of the dominance of road transport in the use of aggregate is that it will likely be the Department of Transport and those municipalities engaged in road construction that bear the cost of any levy imposed for rehabilitation purposes. This will depend on the extent to which pit and quarry operators are able to pass on to their customers any such levy.

Aggregates and sand and gravel are relatively inexpensive, costing some $5.50 to $8.50 per tonne at the quarry gate. The materials are consumed in huge quantities in road building and construction. The delivered price of these materials can have a significant effect on the costs of housing, roads and other construction in the Province. Low prices for these materials are in the interest of taxpayers, house buyers and developers. It is in the interests of all, therefore, that any measures adopted to encourage rehabilitation take into account the possible impact on the final users of the products and that any rehabilitation carried out is carried out as efficiently as possible.

4. The Number of Sites

The number of sites will give some indication of the scale of rehabilitation required. This will be underestimated as abandoned sites are excluded.

Table A1.2
The Number of Active Sites Reported*

	1981	1982	1983	1984	1985
Crushed Stone	12	15	11	12	17
Sand and Gravel	31	42	46	58	63
Gypsum	5	5	5	6	6
Limestone	5	5	5	5	5
Totals	53	67	67	81	89

Source: Nova Scotia Department of Mines and Energy Annual Report.
*excluding:
1) non-reporting operators, i.e., those producers, a majority of whose output is supplied to the Department of Transport.
2) abandoned sites.

These figures should be treated with caution. As noted above, the survey methodology has changed and this has led to the inclusion of more producers in the later years. Thus, the increase in the number of operators will include not just new sites but also sites that were previously not captured by the survey.

5. Income Produced

It is useful to have an indication of the income generated by the industry. Because of the difficulties of data, income can only be estimated. Table A1.3 provides an estimate of the trend of wages and salaries in the aggregate industry.

Table A1.3
Estimated Value of Wages and Salaries in Nova Scotia Quarries and Sand Pits

	1981	1982	1983	1984	1985	1986	1987
$ million	7.132	4.955	5.723	7.886	7.631	6.474	7.758
Percentage of Value of Output	26%	23%	18%	19%	15%	15%	16%

Source: Statistics Canada: "Quarries and Sand Pits" Catalogue No. 26-225

These estimates have been calculated from the Statistics Canada data by taking the proportion of wages in the total value of output of those Nova Scotia operators classified as S.I.C. 081 or 082 and applying that proportion to the value of all aggregate output as reported by Statistics Canada.

In so far as the Statistics Canada data underestimates the volume of aggregate output in Nova Scotia, the table will underestimate the total value of wages earned in the industry. On the other hand, the Statistics Canada data for wages and salaries contains a larger than average production of specialized sands which tend to involve

a greater than average wage element. This data will tend to overestimate wages earned in the industry.

The figures are of interest in that they suggest a decline in the share of wages and salaries in the value of output. This follows upon a decline in the value of output (of sand and gravel) from 1981 to 1982. Producers reduced their labour requirements and this reduction has not been completely recovered.

6. The Returns to Capital

Also of interest is the amount of income earned by capital. This is estimated from the Statistics Canada data by deducting wages and salaries from the figures for value-added. The value added figure already excludes the cost of materials, fuels, services and supplies. The residual is the sum available to pay royalties, the cost of the use of the land and the cost of the capital invested.

Table A1.4
Estimated Net Revenue in Nova Scotia
Quarries and Sand Pits

	1981	1982	1983	1984	1985	1986	1987
$ million	10.85	9.95	14.59	20.78	22.60	20.75	21.86
As % of Value added	40%	45%	47%	48%	47%	47%	46%
$ per tonne of output	1.05	1.66	1.55	1.65	1.70	1.74	1.71

Source: Gardner Pinfold, Statistics Canada "Quarries and Sand Pits," 26-225, Tables 1 and 6.

Table A1.4 estimates the amounts available to producers for interest payments, rent (and royalties if any) and profit.

From this it can be seen that a levy of ten cents per tonne could be expected to have relatively little effect on these amounts. A ten cent levy would represent approximately from five to six and a half of one percent of the estimated net revenue in most years. Only in 1981 is it higher, reaching nine and one half percent in what was a difficult year for the industry.

An interesting feature of the table is that the share of value added going to capital has increased in absolute terms, as a share of the income generated and as proportion of the value of output. This is consistent with the data on wages and salaries. The likely explanations are that the industry is becoming more capital intensive and that the industry has become more profitable. Over time, these two forces are likely to result in a concentration of the industry with fewer and larger firms as the scale of the capital required rises and makes it more difficult for smaller firms to enter.

APPENDIX TWO

APPENDIX TWO

1. The Inventory: Pit and Quarry Site Classifications and Data Collection Form

This appendix describes the classification systems developed to categorize sites in terms of their rehabilitation potential and the scope of the study. A copy of the Pit and Quarry Inventory data collection form is also included.

2. Main Classification System

No Rehabilitation Work

A. Held In Reserve

An inactive, licensed site for which the known resource is being held for future extraction. No major excavation has taken place other than exploratory work, i.e., test pits or drill holes and supporting infrastructure such as roads and staging areas.

B. No Rehabilitation

An active or inactive site with no evidence of any rehabilitation and little or no natural revegetation.

C. Revegetating Naturally-Active

An active site with significant areas of volunteer vegetation on disturbed worked out portions of the site; no planned reshaping of site or directed rehabilitation efforts.

D. Revegetating Naturally-Inactive

An inactive site or abandoned site with significant areas of volunteer vegetation on disturbed portions of the site; no planned reshaping of site or directed rehabilitation efforts.

Evidence of Rehabilitation Work

E. Preliminary Rehabilitation

An active or inactive site on which rehabilitation earthwork is in progress but revegetation or re-use has not taken place.

F. Progressive or Sequential Rehabilitation and Re-Use

An active site in which both planned rehabilitation work and revegetation/re-use are taking place as extraction continues. Includes temporary re-use of worked out portions of the site with permanent after uses intended.

G. Completed Rehabilitation

An inactive site in which all extraction activity has ceased and all rehabilitation earthwork and revegetation has been completed and the site is ready for after use.

H. Re-Use

An inactive site in which all extraction work has ceased, all rehabilitation work is completed, and site is in re-use.

3. Secondary Classification System

Duration of Extraction Process

10 Years

Short-term operations that are easily controlled by rehabilitation legislation, i.e., after use is relatively easy to predict and plan for in a manner which will allow a rehabilitation plan to be formulated prior to the commencement of the extraction process. This concept rests on the economic and social implications of being able to forecast trends with some degree of certainty.

10-40 Years

Intermediate - term operations that are less easily controlled by rehabilitation legislation other than "restoration" or "rehabilitation" type legislation simulating near original conditions as the economics of market influences and long term social goals and after uses are less easily defined.

40 Years Plus

Sites on which the extent of the reserve and operation is very long term making it difficult to plan for after use as depth and extent of excavation often places the site in a category whereby it is difficult to carry out final rehabilitation activity in early stages of the operation, i.e., the site is excavated to depths well below the water table, and quantity of extracted and dump material is excessive in comparison to available overburden and topsoil stockpiled to restore site to original contours.

Abandoned or Derelict Land

Sites which require special attention due to owner relinquishment of site and rehabilitation activity. These sites will require special legislation at both the provincial and municipal levels to reclaim them to a more useful social and economic purpose and to mitigate their often severe visual contrast with the adjoining landscape and environmental disharmonies.

4. Pit and Quarry Inventory Classification Form

The form used to collect the data for the inventory is shown below.

Pit and Quarry Inventory

1. Site Identification _____ Site Map No. _____
   Operator _____
   Owner _____ Date _____
   Address _____ Recorder _____
   Town/Village _____ Pit _____
   County _____ Quarry _____

2. **Operation** Mineral Type _____
   Site Area _____ Site Substrate _____ (D. to B.R.) _____
   Disturbed Area _____ Licensed; Dates _____
   Reclaimed Area _____ Active _____ No Longer Licensed _____
   Years of Reserve _____ Reserve _____ Abandoned _____

   Rehabilitation Plan on File _____ Legislative Jurisdiction DME ___ DOE ___
   MUNIC _____
   Date _____ ENV. CAN. _____
   Duration 0-10 Yrs. _____ 10-40 Yrs. _____ 40 Yrs. + _____

3. **Site Classification** (One or more may be applicable)
   A. Held In Reserve - Inactive _____
   B. No Reclamation - Active/ Inactive _____
   C. Revegetating Naturally - Active _____
   D. Revegetating Naturally - Inactive _____
   E. Preliminary Rehabilitation - Active/Inactive _____
   F. Progressive or Sequential Rehabilitation and Re-Use - Active _____
   G. Completed Rehabilitation Inactive _____
   H. Re-Use - Inactive _____

4. **Natural History of Nova Scotia Theme Regions Classification**

Region _____ Unit _____

Geology _____ Comment _____

5. **Land Use**

Surrounding Area _____ Zoning _____

Use of Rehabilitated Areas:

Forestry _____

Residential _____

Commercial _____

Educational _____

Agricultural _____

Recreation _____

Industrial _____

Institutional _____

Conservation _____

Derelict Land _____

Other _____

Potential After-Uses if not already evident _____

6. **Drainage:** Accommodated by ponding, surface runoff, structures, etc.

_____

_____

Excavation above/below water table.

_____

7. **Wildlife Habitat**

Simple Monoculture _____

Moderately Complex (2 or more eco-systems i.e., grassland, forest, wetland, water, etc.)

_____

Complex (3 or more ecotypes with evidence of intergradation)

_____

8. **Visual Contrast with Surrounding Landscape**

Evident: obvious, strong contrast due to earthform, color and vegetation on-site _____

_____

Not Evident: little contrast to adjoining landscape - major disturbance of original form is not obvious _____

9. Vegetation Cover _____ % Type _____

10. Natural Amenities _____

11. Availability of Topsoil Quality _____

12. **Rehabilitation Comment** _____

_____

_____

_____

_____

_____

_____

13. **Photograph/Site Map Attached**

APPENDIX THREE

APPENDIX THREE

1. Legislative Jurisdictions in Nova Scotia, Existing and Proposed

1.1 Legislative Jurisdictions Responsible for Various Aspects of Pits and Quarries

There are seven Nova Scotia Provincial Government Departments which have some involvement with the control of pits and quarries. These Departments are Mines and Energy, Environment, Health and Fitness, Transportation and Communication, Labour, Municipal Affairs and Lands and Forests. The following chart identifies each Department with a listing of the relevant Act(s) and/or responsibilities which affect the control and operation of pits and quarries in Nova Scotia. The chart is followed by a brief description of each act and its relevance to pits and quarries.

The *Mineral Resources Act* controls the establishment and operation of mines in Nova Scotia, both surface and underground operations. The primary emphasis of the Act is to control designated minerals, e.g., coal, anhydrite, etc. Aggregates are excluded from this Act. However, in Section 5(1) of the Act there is room in special circumstances that would allow the Governor in Council to declare particular aggregates to be a mineral. In addition, it is felt that surface mining has much in common with pits and quarries, and much can be gained through the knowledge of its respective rehabilitation techniques.

Beaches Preservation and Protection Act (1975) excludes beach material as an aggregate resource for pit and quarry operators.

Environmental Protection Act (1973) identifies procedures, regulations and guidelines for the purpose of protecting the natural environment. Section 23(2) states:

> No person ... shall remove any material from the environment, the removal of which causes or tends to cause pollution, without a permit from the Minister.

Department of Mines and Energy	Department of Environment
• Mineral Resources Act	• Water Act • Environmental Protection Act • Pit and Quarry Guidelines • Guidelines for Excavation of Slate Bedrock • Environmental Guidelines for Surface Mining

Department of Labour	Department of Lands and Forests
• Metalliferous Mines & Quarries Regulation Act	• Provide Approval of Aggregate Removal from Crown Land

Department of Transportation and Communication	Department of Municipal Affairs
• No Formal Regulations, utilize D.O.E. Guidelines?	• Planning Act • Municipal Act • Towns Act

Department of Health and Fitness
• Health Act

The following guidelines are attached to appropriate permits for excavation:

- Pits and Quarry Guidelines 1987
- Guidelines for the Excavation of Slate Bedrock
- Environmental Guidelines for Surface Mining Operation 1981

"Pit and Quarry Guidelines" provide some measures for site rehabilitation. A more detailed description of measures is discussed in Section II.

"Guidelines for the Excavation of Slate Bedrock" delineates methods for pollution control, specifically the effects of acid water caused by the removal and exposure of pyritic slates to oxygen through the activation of a dormant bacillus contained in the slate. Presently, changes are proposed to allow for more rigorous testing to control pollution caused by mined slates. The guidelines provide no specific allowances for site restoration.

"Guidelines for Surface Mining" require in plan, the necessary measures "to protect the environment from unnecessary degradation during and following the mining operation". Section 8(a,b,c) of the Guidelines require that reclamation and rehabilitation be carried out as described in the plans, and that progressive rehabilitation be conducted, and that the site be rehabilitated with a permanent vegetation cover, or otherwise stabilized to the satisfaction of the Minister. A bond in the amount of $5,000 per hectare is posted for rehabilitation. The bonding process is handled by the Nova Scotia Department of Mines and Energy. The primary emphasis is on the re-contouring of disturbed lands to approximate original landform.

Water Act controls all fresh water resources in Nova Scotia. Any pit and quarry operations which may affect any surface or ground water system, must obtain a permit from the Department of Environment and adhere to restrictions imposed. If construction of sewage disposal systems is required, joint approval is necessary from both the Department of Environment, as well as the Department of Health and

Fitness. The joint approval is based on requirements stated in the Water Act and Health Act.

Metalliferous Mines and Quarries Regulation Act regulates the health and safety of mines and gravel quarries prior to the start of operation, during operation and upon abandonment.

Lands and Forest Act controls the sale of aggregates and the collection of royalties for aggregates removed from Crown land.

An Act Respecting Environmental Assessment 1988. The most recent regulations (July 1989) of the Act require that newly established pits and quarries which are more than 4 hectares in size will be required to enter a planning process with respect to an environmental assessment. Considerations include:

- the location of the proposed undertaking, and the nature and sensitivity of the surrounding area;
- the size and scope of the proposed undertaking;
- concerns expressed by the public about the effect of the proposed undertaking on the environment;
- anticipated environmental effects of the technology to be used in the proposed undertaking;
- project schedules where applicable;
- planned or existing land use in the area of the undertaking;
- other undertakings in the area; and
- such other criteria as the Minister may determine.

Planning Act sets up procedures for the use and development of land which gives the Province the prime authority for land use planning. Sections of the Act which are relevant to pits and quarries are as follows:

Section 7(2)(1)

Provincial land use policies may consist of statements of policy with respect to any or all of the following:

- the use and protection of the land resource of the province including:
- sand, gravel and rock deposits.

Section 38(1)

A municipal planning strategy or an intermunicipal planning strategy shall include any policies necessary to carry out the intent of applicable provincial land-use policies.

Section 38(2)

A municipal planning strategy or an intermunicipal planning strategy may include statements of policy with respect to any or all of the following:

- subject to any other enactment, the protection of pits, quarries, and aggregate deposits.

Section 53(3) (LUB)

The by-law may:

- regulate the location of developments adjacent to pits and quarries.

Section 54(1)

Where a municipal planning strategy so provides, a land-use by-law may:

- regulate or prohibit the altering of land levels, the excavation or filling in of land, or the removal of soil or other materials from the land, unless these matters are subject to another enactment of the province.

It is interesting to note that the establishment of pit and quarry operations is not considered a use of land within the province of Nova Scotia and therefore, site locations can not be planned for in advance of development. Rather, mining is considered a taking or consumption of land.

1.2 Provincial Land Use Policy

The Nova Scotia Deputy Minister Committee on Land Use Policy — Aggregate Issue Group, recommended in their report of 1978, that: "The Planning Act should be amended to establish pits and quarries as a land use, which can be included in zoning by-laws." Appropriate measures were taken to implement this amendment during the 1978 Planning Act Review. However, these measures have not met with success.

1.3 Municipal By-Laws

By-laws of the Municipal Units which fall within our study area have been reviewed to determine their impact on pit and quarry establishment, operation and rehabilitation.

Halifax County

There are two by-laws in Halifax County which affect Pit and Quarry operations, these are:

- By-Law No. 41
- Excavation By-Law and By-Law No. 40
- Top Soil By-Law

Section 7 and 11 of the Excavation By-Law states that owners or operators of the gravel pit or quarry "shall restore the surface of such land to such condition, no more unsightly than before the operations were conducted."

Section 5(1)(b)(c) provides that where there has been removal of topsoil and grade alterations "site rehabilitation shall be carried out on a progressive basis each

season" and that testing will be required of soil types to determine suitable permanent vegetation cover.

The Excavation By-Law limits the restoration of sites based on a visual assessment of the site prior to operation. This does not ensure natural productivity of the land, nor does it allow for any innovative after uses of the site.

Municipal Act & Towns Act provide authority to municipalities to regulate and license gravel pits and in particular to require rehabilitation of sites.

An Act Respecting the Municipality of the County of Halifax 1973 allows Council to make by-laws "regulating and controlling the cutting of trees, movement of topsoil, movement of gravel, movement of earth, alteration of grade of land and blasting rock".

1.4 Minerals and Aggregates

The following chart illustrates which minerals and aggregates are extracted through surface mining or pit and quarry operations in Nova Scotia, and the relevant legislation which regulates site rehabilitation.

Extraction Method	Legislation	Minerals
• Surface Mining • Shaft Mines and Surface Waste Disposal • Surface Operations Area	• Mineral Resource Act 1975 • Environmental Protection Act • Dept. of Environment Guidelines for Surface Mining	• Coal • Silica Sand (only) • Crown Limestone • Barite • Celestite • Tin/Silver/Copper • Gold • Anhydrite

Extraction Method	Legislation	Minerals
• Pits and Quarries	• Environmental Protection Act • Dept. of Environment • Pits and Quarry Guidelines/1987	• Unconsolidated earth, sand and gravel • Consolidated Rock • Clay • Shale • Marble, Limestone • Gypsum Gravel • Building Stone

2. Existing Nova Scotia Rehabilitation Legislation and Guidelines

In order to understand the context in which rehabilitation is considered in Nova Scotia the following definition has been provided.

The definition provided by the Department of Environment for use under the "Pit and Quarry Guidelines/87" is:

> Grade a disturbed area to agreed contours and stabilize the area with a permanent vegetation cover.

Definitions provided under the Nova Scotia Department of Environment *Guidelines for Surface Mining* are:

> "reclamation" means those remedial measures necessary to alleviate or eliminate conditions arising from surface mining.
>
> "rehabilitation" means the stage of activity following reclamation, comprising land development for environmental improvements of a disturbed area.

Presently, there is no definition of rehabilitation or reclamation provided in the Mineral Resources Act/75.

Rehabilitation techniques required in Nova Scotia are as follows:

Security Deposit

A bond or certified cheque is required by operators prior to the operation of a pit, quarry or mine for the purpose of eventual rehabilitation. The formula for determining the amount of the bond varies. For mines in Nova Scotia, it is based on a site specific assessment. The assessment is according to agreed plans for site rehabilitation and the estimated costs required to conduct the restoration. For pits and quarries it is based on a formula of $2,000 per acre of active area. (Active area is defined: "to include the site working face, locations where topsoil, overburden, and bedrock are disturbed. All buildings, structures processing facilities, pollution abatement systems (i.e., settling ponds) and product stockpiles located in the pit or quarry property". — D.O.E. Pit and Quarry Guidelines), 1987. For surface mining the formula is $5,000 per hectare of disturbed area.

Bond money is refunded as rehabilitation is completed.

It is important to note that presently there is no specific provision in the existing N.S. Mineral Resource Act/1975 for rehabilitation of mine sites. The only reference is Section 16,1,b — Powers of the Minister — which states, "The Minister, with the approval of the Governor in Council, may make regulations, respecting the restoration, reclamation and rehabilitation of a mine or mining lands". The existing

practice of bond requirements is Departmental Policy, not backed up by Cabinet directive or legislation.

In the case of pits and quarries there is no existing legislation in Nova Scotia for rehabilitation. Security deposits for pits and quarries are based on "Pit and Quarry Guidelines"[A1] prepared by the N.S. Department of Environment - 1987. These guidelines are not regulations and carry only departmental authority. These guidelines are attached to permits for pollution control under the Environmental Protection Act with no emphasis on rehabilitation.

Surface Mining is controlled by both the Mineral Resources Act and the Environmental Protection Act. Under the Environmental Protection Act, Guidelines for Surface Mining are set forth which require operators to rehabilitate surface mines. Under these guidelines, there is a $5,000 per hectare bond which is required. There is some question as to whether this sum is sufficient to rehabilitate pits and quarries. These guidelines are jointly administered by the Departments of Environment with Mines and Energy.

Rehabilitation of Exploratory Sites

There are no guidelines or regulations for the posting of security deposits for rehabilitation of sites disturbed by exploration activities for mines or pits and quarries in Nova Scotia.

Progressive Rehabilitation

Section II-1 of the Pit and Quarry Guidelines states "that operators of permanent pits and quarries shall, while in operation, progressively rehabilitate the pit or quarry to the final grade and contours indicated on site plan".

A1 These are expected to become regulation by the end of 1990.

Progressive rehabilitation of mine sites in Nova Scotia is done where possible, and is based on consultation and agreement with the Department of Mines and Energy, Department of Environment and the mining operator.

Rehabilitation of Temporary Pits and Quarries

Section II-2 of the Pit and Quarry Guidelines provides for the rehabilitation of sites which are operated on a seasonal or intermittent basis. It states that these sites shall be rehabilitated prior to each temporary abandonment.

3. Proposed Mineral Resources Act/Nova Scotia

3.1 Proposed Mineral Resources Act of Nova Scotia

The proposed new Mineral Resources Act requires that security deposits in the form of a bond are required for the rehabilitation of mine sites. The bond is not only required of a mine in operation but also for the purpose of mining exploration. This means that sites disturbed through mining exploration should be rehabilitated. The Act also gives power to the Minister "to complete rehabilitation with bond money, if the mine or exploration site has been abandoned".

In addition, the work requirement for an annual license remains at $200 per claim for the first five years, then doubles for every succeeding five-year period to a maximum of $3,200 per claim. The increased work requirement is proposed to discourage the continuance of inactive sites.

3.2 Mineral Resources Act — Procedural Requirements

The following two charts illustrate the existing and proposed procedures required of mining operations.

Although gypsum will not be included as a mineral under the Proposed Mineral Resources Act, it will be affected by the Act. New gypsum operations will require a Mining Permit and will be subject to regulations under the Mining Permit. Within these regulations new operations will be required to provide a bond for the purpose of rehabilitation, as well as, a written proposal for rehabilitation plans.

Extensions beyond the area of the mine will be considered a new operation and will require a Mining Permit. With the new Mineral Resources Act, regulations for gypsum operations will be coordinated by both the Dept. of Environment and the Dept. of Mines and Energy.

Existing Act

Exploratory License 1 - 8 years	Development License Indefinite Period of Time	Mining Lease 20 years
Cost $4 per claim	Cost $40 per claim	Cost $80 per claim (Development License)
Must maintain $200 work value for each claim for each year.	These are claims which are to be developed, plans for operation and rehabilitation are required. Must meet D.O.E. Regulations.	When ready to mine, operation must apply for Mining Lease. Survey of claims is required. Royalties taken.
Exploratory work only.	Operation is set up.	Must continue to pay $80 per claim per year.

Proposed Act

Exploratory License Unlimited	Mining Lease 20 years*	Mining Permit Indefinite
$200 per claim to maximum $3,200 per claim	Cost $80 per claim Plans required. Survey required. D.O.E. Regulations apply	No cost If mining stops for 12 months, permit is reviewed and may be forfeited.

* An operation's lease without a mining permit is reviewable every two years.

APPENDIX FOUR

APPENDIX FOUR

1. Legislation from Jurisdictions Outside Nova Scotia

1.1 Ontario

In the course of the consultants research in both the United States and Canada, the Ontario experience has been described as a model for rehabilitation in North America. Ontario introduced a requirement for rehabilitation with the Pits and Quarries Control Act of 1972 and has in consequence had seventeen years experience in the operation of an act requiring. In consequence, the consultants have studied the Ontario experience in some detail.

The main instruments of regulation in Ontario are the Pits and Quarries Control Act and Regulation 784/1986. Together these require:

- Operators to provide a description of proposed rehabilitation plans of the site with their application for a permit to open, establish or operate. To provide an incentive for them to rehabilitate the site, a security deposit is paid. This is set at 8¢ per tonne of material removed from the pit or quarry in the previous year. This amount is collected until a total sum of $6,000 per hectare of disturbed land is achieved. These security funds will be used to rehabilitate abandoned mines if final rehabilitation is not done.

  This money is refunded when rehabilitation is complete. Money may be deducted from the rehabilitation security for progressive rehabilitation. If progressive rehabilitation is conducted the security deposit may be reduced to $1,000 per hectare. Any surplus of funds after rehabilitation of abandoned sites will be refunded and money required in excess of the security deposit will be paid by the former licensee or permittee.

  The legislation also requires a license fee set at 6¢ per tonne, for a total of 14¢ per tonne from each operation. The 6¢ per tonne for the license fee is not refundable. Of the 6¢ per tonne license fee, 1/2¢ per tonne is utilized for the restoration of abandoned sites, while the remaining 5 1/2¢ per tonne is provided to the local (4¢), regional (1/2¢) and provincial governments (1¢). The provincial government will utilize its portion for program administration. The local and regional governments are accountable for the money allocated, however, there are no provisions to ensure the money is used for pit and quarry rehabilitation. This money is seen as a

financial compensation to municipalities from producing pits and quarries.

Aggregate producers of Ontario are also well aware of the publicity value of rehabilitation. The Aggregate Producers Association award a Bronze Plaque Rehabilitation Award to deserving operators who have demonstrated excellence in sequential land use. The award is based on rigorous socioeconomic and environmentally conscious criteria.

The Experience of Rehabilitation in the Aggregate Industry of Ontario

The Pits and Quarries Control Act remains the main provincial legislative instrument for promoting rehabilitation. As noted above, it is currently being replaced with legislation set out in Bill 170 of the Ontario Legislative Assembly. The new bill has received Royal Assent and was proclaimed in September, 1989.

Summary of Changes Introduced by New Act

- The 1972 Act threatened loss of the security deposit for failure to rehabilitate. The new Act adds the power to suspend the extraction operation as a further incentive for compliance.
- It allows the public to initiate charges of non compliance with a rehabilitation plan.
- It greatly strengthens the control over wayside pits requiring them to prepare detailed rehabilitation plans and to post a lump sum deposit prior to extraction.
- It allows the Minister to initiate variations in a rehabilitation plan. Previously only the operator could initiate a variation of plan.
- It requires progressive rehabilitation, a requirement that is now made enforceable by the provision for suspension of licence.
- It provides for a very limited involvement by municipalities in the reviews of an operators performance.
- It makes detailed changes concerning admissible costs and permissible slopes and features of the rehabilitated site.
- The main operational mechanism of site plan, security deposit and inspection remains the same in the new act.

The Scope of the Act

The 1972 Pits and Quarries Act applies only to those areas that are designated for control. These currently comprise all southern Ontario up to the regions of Owen Sound, Huronia, Lindsay, Carlton Place and Cornwall, excluding the districts of Lennox and Addington and Frontenac. The new Act will increase the areas under designation.

The 1972 Act was applied both to existing sites and to new sites. This was an important element for two reasons. Since the life of a pit or quarry may be decades, to have excluded sites already in operation would have allowed the greatest source of nuisance to persist unaffected by the requirement for rehabilitation.

Secondly applying the act and its levy only to new sites would have adversely affected the relative competitive position of the newly opened sites. Excluding existing sites from the provisions would have tended to act against the opening of new sites. It would also have induced operators to continue production at the existing sites for as long as possible. As it is the older sites that are more likely to be closer to urban development these sites are more likely to involve conflicts over land use. To have excluded them from the provisions of the act would likely have been to exclude the major part of the problem.

The Desire for Unified Jurisdiction

The pressure for provincial regulation that resulted in the 1972 Act, came, in part, from the operators of pits and quarries themselves through the Association of Ontario Aggregate Producers (although at its introduction not all producers welcomed the new Act).

The economic growth of Ontario has created an increasing demand for aggregates and this has resulted in conflicts over land use. It is inherent in the nature of the aggregate industry that land use conflicts will arise. To minimize costs the industry has always to be situated close to its place of final use. The industry is a part of the process of development which by definition, changes land use zoning and land values. An aggregate operation that was once in the midst of farm land can

over time come to be surrounded by newcomer homeowners who object to its operations.

These land use conflicts and the resulting opposition to aggregate extraction caused concern to the pit and quarry operators. They were facing increasing opposition, in particular from municipalities, to the expansion of aggregate production and increasing attempts to control existing operations. The municipalities, besides attempting to control the operation of pits and quarries, were also attempting to exact levies from the operators. The industry is particularly vulnerable to such attempts, being tied to the site of the increasingly scarce deposits, it cannot move elsewhere, and municipalities are able to take advantage of this.

The operators accepted provincial regulation in an effort to achieve some uniformity of regulation and some protection for the industry. It would protect companies from being forced to compete against each other in paying fees to municipalities.

The Act has had success in this area but it should be noted that there is still a multiplicity of jurisdiction at the level of the provincial government. Besides the Ministry of Natural Resources, extraction might involve the Ministry of Agriculture if farm land is involved; the Ministry of the Environment has jurisdiction if there is any effects on water supplies, any blasting operations or any requirement for zoning changes; the Ministry of Municipal Affairs has jurisdictions relating to municipalities and zoning. While the operation of the act is intended to coordinate the review of the application by all interested ministries so the operator has only to deal with one ministry, the Ministry of Natural Resources, operators still criticize the procedure.

Municipalities

As has been noted above, the actions of municipalities was a cause for concern by pit and quarry operators. The 1972 Act prevented municipalities from licensing of extraction operations, but municipal involvement did not cease with the Pits and Quarries Control Act. Municipalities still retain some control over land use through zoning by-laws though these are subject to provincial guidelines.

The practice of some municipalities of re-zoning land originally zoned for extraction has effectively prevented this land from being used for extraction. This is of some concern to operators who could suffer capital losses from the practice.

It should be noted that the new legislation contained in the new Aggregate Control Act further restricts the municipalities use of zoning by-laws as a device to control or prohibit extraction. The Act also allows for extraction licences and permits issued by the Ministry of Natural resources to prevail over zoning by-laws.

However, the new Act will make provision for a limited municipal involvement in the review of the operators extraction licence. This review is conducted annually by the inspector. Under the new act the municipalities will, *every fourth review*, be able to comment on the operation of the site and the operators compliance with the terms of his licence.

Municipalities are the recipients of a levy of four cents per tonne of aggregate raised by the province. This is intended to defray any cost of repair of roads damaged by quarry operations. However, it is not always clear that these funds have been expended on roads. Consequently the new bill provides for closer scrutiny by the province of the expenditure by municipalities of these funds.

The crucial point here would seem that while the municipalities are the recipients of the four cents per tonne this is collected by the Province. The municipalities do not levy it and consequently they have no right of taxation over the operators.

However, the consultants were advised by some operators that there are still instances of municipalities seeking, without legislative authority, money from operators to allow extraction to proceed and that in some instances these monies were paid. While this evidence came from a number of sources, it was merely anecdotal and the consultant had no opportunity to raise the issue with any representatives of municipalities.

The current attitude of operators interviewed by the consultants was that rehabilitation was a normal part of extractive operation, that the levy was 'just a cost

of doing business' and that the Act was beneficial to the public profile of the industry. The industry association is in fact currently exploring methods of better publicizing its rehabilitation efforts.

The Impetus for Rehabilitation

The 1972 Act requires a pit or quarry operator to rehabilitate each site and as an incentive the Ministry of Natural Resources collects a deposit of (currently) eight cents a tonne from producers which is refunded as rehabilitation is completed. However, this does not compel rehabilitation. Any operator can simply abandon a site without rehabilitation and treat the lost deposit as a cost of production. The fact that no operator has abandoned a site since the Act came into effect and the fact that some operators are spending above the amount of the levy suggest that other motives are at work

In the opinion of those interviewed the prime impetus for rehabilitating sites is a dynamic one, tied to the growing demand for aggregate, to the need to acquire new zoning permission and new extraction licences, to gain access to new deposits of the resource. To obtain this permission and licence, "a good track record (in rehabilitation) is essential". (However, although a good record is necessary it is not sufficient, as companies with excellent records may be refused licences).

Thus, the *prime* motive (not necessarily the only one) for the rehabilitation efforts made in Ontario has been the desire to gain a licence and permission to take advantage of an expanding market. It is clear also from the efforts that operators devote to zoning and licence applications (where an operator might commonly expect to spend one million dollars and up to five years) that gaining access to new deposits is vital to maintain a competitive position in the Ontario market.

Rehabilitation to communal recreational uses have been a popular device for gaining municipal acceptance. This has often been the case with progressive rehabilitation, with extraction continuing with the recreational use of parts of the site.

The effects of the rehabilitation security deposit scheme have been masked by the greater effect of the imperative to expand production.

The effects of rehabilitation on the value of the land do not appear to have been an incentive *to operators* rehabilitate sites. Operators interviewed by the consultant reported no effect *from rehabilitation* on the value of the site accruing *to themselves*.

There were often gains accruing *to neighboring properties* from rehabilitation of the site.

Gains often accrued to the municipality from the transfer of the site ownership and the rehabilitation.

Gains accrued to the pit operator from increases in the value of the land due to *the development of the region* but those interviewed denied that rehabilitation had any role in this. The interviewees claimed that the grading and contouring necessary for rehabilitation were not always suited to the needs of development. There is some degree of truth in this though any rehabilitation planned appropriately could always be conducted in such a way as to reduce the costs of any regrading for development.)

The fact that the new act is to include the provision for the Minister to suspend the licence of an operator who does not follow his rehabilitation plan suggests that the existing incentives are not felt to be sufficient.

Consolidation of the Ontario Industry

It may be noted that the application of the 1972 Act has been accompanied by a considerable consolidation of the industry in Ontario. This has resulted from two forces, mergers and acquisitions of existing companies and a diminution in the number of new entrants to the industry. On the evidence of the Ontario Aggregate Producers Association since 1972, only ten small companies have entered what has been a profitable and rapidly growing industry.

Two reasons are offered to explain this:

- Older operators are unwilling or unable to make the investment in expertise and equipment necessary to operate in the new atmosphere of environmental concerns and controls. In this context the 'grandfathering' scope of the 1972 Act applying to all existing sites may have promoted retirement of some operators and consolidation.

- Operators have sought access to new deposits for their company by acquiring the deposits of other companies. The acquisition of a company that already has a licence and reserves of aggregate is a cheaper and much less uncertain method than risking the process of seeking a new licence.

Rehabilitation therefore in Ontario has been an important element in regard to applications for new licence. While new licences are important as a means of expansion for the industry as a whole, for individual companies the first means of gaining new access to the resource would likely be by merger with others companies.

This might be less true in Nova Scotia where the market is approximately one tenth of the size of that of Ontario and where growth has less rapid. Thus, in the Nova Scotia context without the same impetus for licensing new aggregate sources, the security deposit may, by default, be a more important factor influencing operators efforts at rehabilitation.

The Rehabilitation Regulatory System

The main instrument of rehabilitation regulation in Ontario is a system of detailed rehabilitation planning required for each site that produces a set of site plans detailing the operation and rehabilitation. This is coupled with a system of inspection by officials of the Ministry of natural Resources and a deposit held as security for rehabilitation. The 1972 Act recognizes three categories of extraction operation and requires different levels of site plan, enforcement and deposit for each.

Categories of Operation under the Legislation

Although the 1972 legislation in Ontario applied to all sites, it provided for three categories of aggregate operation based on volume of output. These are:

- Wayside pits which are small sites used exclusively for projects of the Ministry of Transport and Communications. These sites are drawn from lists prepared by the Ministry of Transport and Communications (after consultation with the Ministry of Natural Resources).
- Class B sites producing less than 15,000 tonnes per year (soon to be 20,000 tonnes).
- Class A sites producing more than 15,000 (soon to be 20,000) tonnes.

The three categories were treated differently.

The Rehabilitation Plan

Planning for rehabilitation is achieved by requiring the preparation of 'site plans' which detail the existing nature of site, the effects of extraction, (plant, water drainage soil materials storage, screening) and the planned rehabilitation. This site plan which, in the case of class A sites will likely be several sheets, form the basic tool of rehabilitation. The plan is not only the product of the planning that is undertaken for both the extraction process and the rehabilitation process, but the plan is also the reference point for judging the progress of rehabilitation.

Treatment of class B sites differed in that they were required to produce a short form of site plan. For both class A and class B sites, the plan must be professionally prepared and is likely to require the services of professionals from several disciplines.

Wayside pits were required only to submit a sketch plan of rehabilitation.

The inspector must give the initial approval for all site plans and provides advice and consultation in preparing it.

Variations to the Site Plan

Minor variations (such as a change in species of plant material to be utilized) to the rehabilitation plan sought by the operator can be approved by the inspector alone; major variations (such as changes in contouring of a major section of site or alterations to the basic rehabilitation plan) must be submitted for review by the Ministry and the other Ministries party to the original approval and the municipalities originally involved.

The 1972 Act did not provide for the Ministry of Natural Resources to vary the site plan. This is being altered in the 1989 legislation to give the Ministry of Natural Resources the opportunity to apply to vary the site plan.

Enforcement

Under the 1972 Act the only method of enforcing rehabilitation was the loss of the security deposit. This was not regarded as sufficient, consequently, under the provisions of the new act, the Minister will have the power to remove the licence of an operator and cause extraction at that site to cease until the conditions of the licence are met.

The enforcement is carried out by inspectors who inspect the sites at least once a year and relate the progress of the rehabilitation by reference to the site plan. The inspector presents an annual report on each site, reviewing operation and rehabilitation.

Wayside Permits

There have been significant changes to the treatment of applications for wayside permits. In the 1972 legislation, a wayside permit required only a sketch map of the site and "a statement or plan of rehabilitation compatible with the amount of material to be extracted and acceptable to the inspector." There was no inspection of rehabilitation; the onus was on the operator to confirm that rehabilitation had been carried out. There was no provision for a security deposit should the operator fail to perform rehabilitation.

Wayside permits could be issued for public road contracts of either the Ministry of Transport and Communications or those of municipalities. In the case of the former, the operator was required to draw aggregates from a list of sites prepared by the Ministry of Transport after discussion with the municipality and Ministry of Natural Resources. Contract could mean road building, repair or winter sanding. In the case of municipal contracts, there was no input from the Ministry of Natural Resources as to choice of site .

This has been changed in the new act. The applicant for the wayside permit will be required to submit much more detailed site plans than previously required, bringing them closer to the level required of the other categories (though they do not have to be professionally prepared).

Also under the new act, the Ministry of Natural Resources will not only collect a permit fee at the same rate as for other categories but will an amount to be paid *before* extraction. This amount will be calculated to anticipate the total proceeds of the fee on the basis of the amount of aggregate to be removed to meet the contract.

The Security Deposit

The security deposit as originally conceived was intended to be the main incentive to rehabilitate. It is levied on each tonne of aggregate extracted.

This is calculated and paid monthly by the company. The inspector by estimating changes to stockpiles and shipping invoices will confirm these sums.

A schedule of the rehabilitation work performed by the operator, describing each type of activity, its cost and its relation to the rehabilitation plan, is submitted each year to the inspector. He examines it, inspects to verify, allows the appropriate proportion of cost for each item, and credits the operator with the amount up to the value of the security deposit.

The operators are allowed to use their own equipment for the rehabilitation and to charge for this at an agreed rate. Many operators do this for backfilling, sloping and regrading using the winter months when demand is moderate and can be supplied from stockpile and the equipment is available. The effective cost (opportunity cost) of such a procedure is very low and operators confirmed to the consultant that this process was much less costly than using contractors.

One difficulty reported by the Ministry of Natural Resources was that the definition of admissible costs allowed some operators to claim a rebate of their security deposit for work done purely for the purposes of extraction. This has been dealt with by changes to the definitions of admissible costs.

The security deposit system operates with a minimum and a maximum. Thus the deposit is payable on each tonne extracted up to a maximum of (currently) $6000 per hectare of disturbed land. Conversely a minimum of $1000 is payable per hectare of disturbed land even if insufficient aggregate is extracted to accumulate this amount.

It is the understanding of the consultant that the maximum was introduced at the behest of the operators to set a limit to their liability. This may be a desirable method of assisting the introduction of a new rehabilitation act, however, it does have disadvantages. It may not cover the total cost of rehabilitation at deep pits and quarries. It will favour more intensive extraction to maximize output per hectare. This will make the task of rehabilitation more difficult.

The use of the minimum is intended to deal with the problem of abandonment of small sites. In such cases, the cost of the rehabilitation if the Ministry had to step in and plan the rehabilitation from scratch using contractors would be considerably greater than if it was conducted by the original operator during the course of the extraction.

Progressive Rehabilitation

A survey conducted by the Ministry Of Natural Resources as to the impact of the 1972 Act, found that in any one year, the majority of operators carried out no

rehabilitation. This implied that these operators were not progressively rehabiiitating their sites, despite the fact that this method is known to be most cost effective for most sites.

This problem was associated with smaller site. The larger operators who had both larger sites and more sites did practice progressive rehabilitation. This is partly a consequence of the larger sites. These have often been in existence for some time often originally in family ownership and these two factors tended to result in a commencement of rehabilitation efforts while extraction continued.

Larger operators also tended to be more concerned with expansion and the acquisition of new reserves and as noted above, this made the adoption of best practice rehabilitation an matter of necessity.

The security deposit was not a major impetus for progressive rehabilitation. However, the provision made in the new act for the suspension of the extraction licence should give greater power to enforce progressive rehabilitation.

Training

The operation of the act in Ontario depends on the application of a body of expertise that has been acquired and developed over seventeen years. Ontario now has consultants, operators and officials who are trained in rehabilitation and the operation of the act and who are crucial to the success the act has had. Operators repeatedly emphasized to the consultant the importance of their liaison with the rehabilitation inspectors. The inspectors are the linchpin of the act, they provide daily decisions and advice as to acceptable practice. Operators in consequence were very concerned with the need for consistency in these decisions between different inspectors.

The introduction of any rehabilitation act would generate a requirement on the part of operators and government for the requisite expertise. This is likely to be particularly acute in the initial stages until experience in the operation of the act has been developed.

The Ministry of Natural Resources has 25 inspectors covering the currently designated areas. These each oversee an average of some eighty pits and quarries. They are drawn from a variety of educational backgrounds but training in resource management, planning, geology, geography and forestry is common.

There is no formal training program, it consists of courses drawn from other training programs. These include courses for planning inspectors, courses on zoning by-law courses on the protection of the resource, on courtroom procedures for laying charges and courses of the Ministry of Transport on revegetation. There is no specific rehabilitation course and no such program exists.

1.2 Alberta

The Land Surface Conservation and Reclamation Act 1983 provides for the establishment of a Land Conservation and Reclamation Council (LCRC). The Land Conservation and Reclamation Council members are comprised of representatives from the Alberta Department of Environment and the Department of Forestry, Lands and Wildlife. This committee is responsible to ensure that disturbed land is returned to the same productivity as the site was capable prior to disturbance. Each of the departments employs Government Reclamation Officers who are responsible for the inspection of rehabilitation requirements.

Pursuant to Section 38, 39 of the Land Surface Conservation and Reclamation Act, the following are the minimum rehabilitation requirements for operators. These requirements are listed by the LCRC as quick reference for operators and it is understood that terms and conditions specified in approval procedures take precedence.

- All surface disturbances should be kept to a minimum, with appropriate measures taken to control wind and water erosion.
- All trees should be salvaged or removed and disposed of by burning or other methods and approved by the Council.
- Topsoil, including the surface organic horizon of the soil profile, should be selectively removed from the disturbed area and conserved for the reconstruction of the root zone.

- All debris from the operator's equipment and facilities should be removed from the site and all solid materials should either be removed, or when necessary, buried with a minimum of 1.20 meters of soil cover.
- The disturbed area should be recontoured to conform to the surrounding topography.
- Topsoil and root zone material should be spread evenly over the entire area after it has sufficiently settled.
- Areas when vegetation has been disturbed should be cultivated or conditioned to be compatible with adjacent or post-disturbance land uses.
- On public lands the operator should attain a permanent maintenance-free plant cover that is compatible with vegetation on adjacent undisturbed lands.
- Proper land management and rehabilitation, including erosion control and debris and waste disposal, should be conducted as the site operations progress.

Security deposits for rehabilitation of surface coal mines, sand, gravel, clay and marl operations is required. The formula for the deposits vary and it outlined in the chart on pages 36-38.

1.3 United States

The primary rehabilitation legislation in the United States is the Federal Act directed toward the rehabilitation of surface coal operations. Individual States may provide for more stringent legislation but they must, as a minimum, adhere to the Federal Act.

The Surface Mining Control and Reclamation Act 1977 provides for a national environmental protection and rehabilitation program for surface coal mining sites. Within the Act there is provision for State regulations, however, these regulations must meet the standards of performance set forth in the Act. The Act controls water pollution and protects scenic areas. Performance bonds are required for the rehabilitation of existing sites and a levy is set for the rehabilitation of

abandoned sites. Site rehabilitation must be to at least a level which would support uses for which it was capable of supporting prior to operation.

A weakness of the Surface Mining and Reclamation Act is described in a paper authored jointly by Walter Davidson of West Virginia and Donald Graves of University of Kentucky. It suggests that requirements such as "extensive grading and up to four feet of new topsoil cover may result in extremely compacted soils and rapid establishment of vegetation cover results in severe competition for tree seedlings, the outcome is a minimal effort to establish and culture trees on mined lands".

The authors also noted a change in philosophy of mining and land use in the 1970s. "Mining is considered an interim use of land with a look to the future for a long term or end use", of which forestry may well be incorporated and planned for in advance of extraction.

It is through the integration of mining, rehabilitation and land use planning that operators in the United States are now considering an end use.

A Study of Mineral Mining from the Perspective of the Surface Mining Control and Reclamation Act of 1977 prepared by the National Research Council identified that most of the non-coal mineral mines, with a few exceptions, were not amenable to the coal mining rehabilitation practices described in Section 54 of the Act. The report discusses comprehensive planning which considers social, economic, and environmental factors, as an appropriate tool to solve problems related to non-coal minerals. It suggests an institutional approach to controls, which avoids the implication that regulations are the only means of control.

Two weaknesses addressed were: 1) dispersed planning and administrative functions between various levels of government and department results in the poor coordination of local, state and federal governments; and 2) existing institutional procedures for planning often do not consider mining as an aspect of land use.

However, as stated earlier, more recent information provided by Davidson and Graves indicates a change in attitude and perception. There now seems to be a

better level of acceptance for surface mining as a use of land and greater coordination among levels of governments and agencies.

1.4 Britain

Legislation

In Britain rehabilitation legislation for the planning and funding of restoration for coal and ironstone operations has been active since the 1940s and '50s. The 1947 Town and Country Planning Act was the first piece of legislation which required the rehabilitation of sites after closure. In addition to site rehabilitation, the Act recognized the importance to protect potential resources and placed greater planning and control with local authorities. This recognition continued through its inclusion within the 1968 and '71 Town and Country Planning Acts, and the 1981 Minerals Bill.

The setting of a levy on mineral extraction for the purpose of site restoration dates back to the Mineral Workings Act of 1951, and in a broadened form continues today.

Prior to 1981 grants were made available to both public and private sectors for rehabilitation. These grants were mainly utilized to ensure site safety and improve visual appearance. With the location of most derelict mining and quarrying operators in the countryside, most rehabilitation was tailored toward agriculture and forestry. Since 1981, money has been made available through the Derelict-Land Grants Program to encourage other uses such as commercial, industrial or residential.

Other factors which influenced the direction and flavour of rehabilitation of mines in Britain, were rehabilitation research projects instigated through at least two of Britain's universities (Newcastle-upon-Tyne University, 1960; Liverpool University, 1980s) and the involvement of landscape architects in the design of restoration projects. Through their participation, industry was and is provided with a resource base and examples of sensitive, well designed rehabilitation projects.

Authors of "Mineral Resources in Regional and Strategic Planning", Peter Roberts and Tim Shaw, recognized the progress in mineral legislation and procedures, however, clearly stated the need for National Policy and strategic planning. It is in their opinion that if each application for permission to develop a resource is assessed on its own merits by local authorities, there is a potential to severely restrict, or exclude the industry so as to create shortages. Evidence of this is seen in South East England today.

Summary

The following extracts from Landscaping Planning by Tom Turner summarize the Legislative and Planning Techniques utilized to control surface mining in Britain.

- Bonds for land rehabilitation — useful but tends to encourage the idea that rehabilitation can be left until completion. In short-lived mines, rehabilitation should be integrated with extraction process.

- Controls for working practice — this sets up a defined set of standards of operating techniques before starting a new pit — Disadvantage is that it is difficult to enforce.

- Phase permit to work mineral — this method of control requires that progressive rehabilitation work and working practice be assessed yearly prior to authorization of new permit to operate.

Notes:

- permits for operation would have to be issued yearly.
- requires personnel to monitor yearly each operation.
- standard of comparison would require full assessment before mining began.

Planning Techniques

- *Zoning* — can be used for ubiquitous minerals but not for scarce minerals.

- *Concealment* — hides mine sites, through use of tree screens, ridge lines, etc., one of the least contentious methods, however, it does not control traffic, noise, dust, etc. — Concealment approach

usually leads to "back-to-contour" restoration philosophy. Back to contour restoration may not be appropriate in all cases and tends to be costly.

- *Conservation* — land should be restored and not left in derelict condition — Legislative controls are required to restore land for agriculture or forestry.

- *Innovation* — "rehabilitation" to describe the innovative approach. Land returned to a form and productivity which conforms to prior land-use plan including a stable ecological state. Separate policies may be required for each aspect of the operation.

1.5 Scotland

A Policy for Aggregate Extraction prepared by the Grampian Regional Council in Scotland developed a three tier system for controlling and planning aggregate extraction. The tier system sets up a hierarchy for designating areas capable and suitable for aggregate extraction. The first tier is the most restrictive while the third tier is the least restrictive. Land uses within the first tier would include such land uses as top quality agricultural land, National Nature Reserves, and Statutory Conservation Areas.

The aims and functions of the aggregate policy are as stated in the report:

- "to ensure adequate available quantities of aggregates, with planning permission for their extraction, to meet market requirements;

- to identify important types of the Region's environment and ensure that they are not irreparably ruined by mineral extraction;

- to ensure that planning permissions, where granted, are subject to uniform minimum standards of development control;

- to assist operators in identifying areas considered for mineral extraction".

The Grampian Region is one of the more progressive planning regions in Scotland and has established procedures for rehabilitation activity in advance of other areas.

APPENDIX FIVE

APPENDIX FIVE

The Costs of Rehabilitation at Three Sites

Two examples of rehabilitation from Ontario have been translated into the Nova Scotia cost environment. Both are examples of progressive rehabilitation, where the land is rehabilitated a section at a time while extraction continues. All of the Ontario cost data was recalculated in terms of Nova Scotia cost coefficients.

Rehabilitation to grass was taken as the minimum standard of re-use to which the rehabilitated land could be put. In actual practice in Ontario, the site was rehabilitated to orchard at a considerable cost, which does not enter the calculations below. This has not been adopted in the example, as fruit production was seen as an unlikely re-use for the Nova Scotia context.

The re-use of the land as woodlot is more likely in Nova Scotia. This could be modeled by substituting costs for seedling stocks for costs of grass seed.

The costs relate to 1988. The revenue figures given in Table A5.2 relate to 1987 costs and revenues.

The rehabilitation consisted of the tasks laid out in Table A5.1. Costs on a per task basis and a total basis are also presented in the table.

Rehabilitation in Context

The cost of rehabilitation, $71,000 for the eight hectares is a significant sum but it will be incurred over a period of at least two years.

It should also be put in the context of the wealth generated from this section of the site. If, as was the case, the site yielded a forty foot deposit over the entire eight hectares rehabilitated, it would have yielded over two million tonnes of sand and gravel from this portion of the site. (Fifteen percent of output was too fine for use and was lost.)

Example One - Progressive Rehabilitation of an Eight Hectare Section of Site to Grass

The rehabilitation consisted of the following tasks:

Table A5.1
Progressive Rehabilitation of an Eight Hectare Section of Site to Grass

Task	*Equipment/Personnel*	*Time Hours*	*Rate/ Hour*	*Total Cost*
1) Surveying and Setting Grade Stakes	Contract Survey Crew		$170/hectare	$1,361
2) Levelling & Grading	Caterpillar D8L	102	$173.25*	$17,671
3) Loading Soils	Caterpillar 980	98.75	$177.45*	$17,523
4) Hauling Soils	Euclid/Terex	166.75	$140.00*	$23,345
5) Ripping Floor	Caterpillar D8L	34	$173.25	$5,890
Total Grading Costs				**$65,790**
Total Grading Costs Per Hectare			**$8,223**	
6) Rock Picking/ Windrowing	Farm Tractor 50 h.p./ Rock Picker	20	$45	$900
7) Spreading Paper Waste/ Soil Enhancer	Case Backhoe	20	$55*	$1,100
	Manure Spreader/ Tractor 50 h.p.	20	$15.44**	$158
8) Disc Harrowing	Tractor/Harrow	7	$19.58/ha**	$391
9) Drag Harrowing	Tractor/Harrow	8	$23.09/ha	$461
10) Fertilizing¶	Tractor/Spreader	4	$155.60/ha	$1,593
11) Seeding Grass§	Tractor/Spreader	3	$43.77/ha	$448
12) Spraying	Tractor	3	$15.44/ha	$158
Total Cultivation Costs				**$5,209**
Total Cultivation Costs per Hectare			**$651**	
Total All Costs				**$70,999**
Total All Costs per Hectare			**$8,875**	

* Based on Nova Scotia Road Builders Association hourly rate for equipment rental.

** Based on Nova Scotia Department of Agriculture Farm Management Fact Sheet "Average Cost of Grass Hay Production". These costs are calculated per hectare. These have been adapted in several points.

Farm labour is charged at $15.00 an hour. This is believed to be a typical cost charged by farmers for their (and their employees) contracted services.

It assumes that fixed farming costs (including depreciation of equipment) are not charged.

It assumes that materials costs increased by 5% in each of the years 1986-1988.

It also assumes 28% more hours are required per operation than the average for Nova Scotia grass production. This is a deliberately pessimistic assumption based on the Ontario experience for harrowing.

¶ Assumed to be 12-24-24 fertilizer at the rate of 330 kg/ha and a cost of $.33/kg.

§ Assumed timothy mixture at 22 kg. per hectare at a cost of $7.37/kg.

Note: No cost estimate was available for the creation of a rehabilitation plan. Depending on the detail and complexity, this could add $10-15,000 to total cost.

Under a levy scheme as operated in Ontario the funds would be raised over the entire extractive life of this section of the pit during which time two million tonnes would be extracted and sold. The proceeds of an eight cent per tonne levy applied to the same volume would have yielded $172,000.

Calculating revenues requires assumptions to be made about the quality of sand and gravel produced and the price earned. Specialty sands such as silica sands can command premium prices. Even for sand for use in construction, quality can vary with every foot of depth. The consequent price can vary from $5.38 per tonne (for ungraded 3" surge rock) to $8.50 (for washed and graded gravel). Price will also vary with the intensity of demand.

Discussion with Statistics Canada have suggested an average price of $5.64 per tonne is a reasonable average price for 1987. If this price is applied to the volume, estimated above, then this portion of the site, *over its extractive life,* would have generated revenues of nearly $8.3 million *at 1987 prices.* Even if these figures for price are reduced to the minimum of $5.38, the revenue would be some $8 million. At the top of the range the revenue earned would be some $12.5 million.

Statistics Canada also provide survey information on the costs, labour, fuel, materials and supplies for several Nova Scotia quarry and sand pit operators. These figures may slightly overestimate costs as they will contain an above average element of costs (as they contain an above average amount of more costly silica sand production), but they can be used to estimate the costs of all operators sand, gravel and crushed stone operations in Nova Scotia.

After labour costs, fuel and material costs are deducted the lifetime revenue generated by the site available for interest, profit and rent would amount to almost $1.5 million. Seventy-one thousand would be some 5% of this.

Table A5.2 summarizes these figures.

Table A5.2 Revenue, Output and Costs of Rehabilitation		
	Total	*Per Hectare*
Estimated Total Lifetime Net Output on eight hectares Tonnes	1,468,392	185,549
Estimated Gross Revenue $5.38/tonne§ $5.64/tonne¶ $8.50/tonne‡	 $7,899,949 $8,281,730 $12,481,332	 $ 987,494 $1,035,216 $1,560,167
Operating Costs	$6,857,390	$857,174
Estimated Net Revenue (*after* labour, fuel, materials, *before* rent, depreciation, interest at 1987 prices)†	$1,424,340	$178,042
Cost of rehabilitation (1988 cost estimates)	$70,999	$8,875
Value of a levy (at 8 cents/tonne)	$117,500	$14,688

§ *Current minimum Halifax price (at quarry) of lowest grade 3" surge rock.*

¶ Statistics Canada Average Nova Scotia 1987 price for sand and gravel.

‡ Upper limit of current Halifax price range washed and graded gravel

† Derived by:
(Price - materials - fuel - wages - supplies) - (shipments - change in inventories)

Sources: Statistics Canada "Quarries and Sand Pits", Tables 1 and 4 and personal communication, Terry Newman, Statistical Supervisor, Energy, Mines and Resources Canada, Resources Branch, Information Systems.

Example Two - Progressive Rehabilitation of a Four Acre Section of Site to Grass

This example is based on the rehabilitation of four acres of a gravel pit in Ontario. The tasks that were performed were:

Table A5.3
Progressive Rehabilitation of a Four Acre Section of Site to Grass

Task	*Equipment/Personnel*	*Time Hours*	*Rate/Hour*	*Total Cost*
1) Levelling & Grading/ Ripping Floor	Caterpillar D8L	43	$173.25*	$7,449
2) Spreading and Grading Subsoil and Topsoil	Caterpillar D8L	25	$173.25*	$4,331
Total Grading and Recovering Costs				**$11,780**
Total Grading and Recovering Costs per Hectare			**$2,945**	
3) Disc Harrowing	Farm Tractor 50 h.p. /Harrow	5	$19.58/ha**	$98
4) Rock Picking Windrowing	Farm Tractor 50 h.p. /Rock Picker	10	$45	$450
5) Removing Roots	Farm Tractor Cultivator	3	$45	$135
6) Drag Harrowing	Tractor			
7) Fertilizing ¶	Tractor/Spreader	3	$155.60/ha	$622
8) Seeding Grass §	Tractor/Spreader	3	$43.77/ha	$175
9) Disc Harrowing Fall Rye late fall seeding	Tractor/Harrow	4	$19.58/ha**	$78
10) Drag Harrowing after seeding	Tractor/Harrow	4	$23.09/ha	$92
11) Fertilizing ¶	Tractor/Spreader	3	$155.60/ha	$622
12) Seeding Grass §	Tractor/Spreader	3	$43.77/ha	$448
Total Cultivation Costs				**$2,622**
Total Cultivation Costs Per Hectare			**$655**	
Total All Costs				**$14,402**
Total All Costs Per Hectare			**$3,660**	

* Based on Nova Scotia Road Builders Association hourly rate for equipment rental.

** Based on Nova Scotia Department of Agriculture Farm Management Fact Sheet "Average Costs of Grass Hay Production". These have been adapted in several points. Farm labour is charged at $15.00 an hour. This is believed to be a typical cost charged by farmers for their (and their employees) contracted services.

It assumes that fixed farming costs (including depreciation of equipment) are not charged.

It assumes that materials costs increased by 5% in each of the years 1986-1988.

Gardner Pinfold Consulting Economists Ltd.
in association with
Robert Parker Associates Ltd.
Peter Klynstra Landscape Architects Ltd.

It also assumes 28% more hours are required per operation than the average for Nova Scotia grass production. This is a deliberately pessimistic assumption based on the Ontario experience for harrowing.

¶ Assumed to be 12-24-24 fertilizer at the rate of 330 kg/ha and a cost of $.33/kg.

§ Assumed timothy mixture at 22 kg per hectare at a cost of $7.37/kg.

Note: No cost estimate was available for the creation of a rehabilitation plan. Depending on the detail and complexity, this could add $10-15,000 to total cost.

Example Three - Rehabilitation of the Milford Shale Pit

The L. E. Shaw Ltd. company has been rehabilitating its Milford Shale Pit over the period 1982-1989. The activities involved and their estimated costs are summarized in Table A5.4. Note that all machine work (i.e., loaders, dozers, trucks, etc.) was done by company equipment. Hourly rates were charged internally at approximately 60-70 percent of the going rate.

Table A5.4
Milford Shale Pit Rehabilitation Activities and Costs

Year	*Activity*	*Approximate Cost*
1982	Backfilling, sloping, and grading of a small portion of the pit, followed by manual seeding and mulching of the area.	$4,500
	Planting white spruce hedge.	$400
1983	Planting 24 Honeysuckle	$350
1984	Phase I - Backfilling, sloping, and grading of southern face (approx. 30,000 tonnes Sept. 14 - Oct. 5), followed by a manual seeding of the area.	$10,000
1987	Phase II - Backfilling, sloping, and grading of western face (approx. 70,000 tonnes June 12 - July 15), followed by fertilizing and seeding with a farm tractor.	$51,300
1988	Picking rock off slope to allow mowing.	$300
1989	Construction of a drainage line, plus backfilling, and hydroseeding of the area.	$4,000
	Erection of safety fence around northern portion of pit.	$3,000
	Backfilling and sloping of portions of northern section of pit.	$2,500
	Planting of approx. 200, 2-4' pine trees (Scotch, Red & White)	$1,800
Total to Date		**$78,150**

Source: Scott Smith, L. E. Shaw Ltd.

APPENDIX SIX

APPENDIX SIX

DEMONSTRATION PROJECTS

One effective way in which the Province and industry can gain more experience in rehabilitation activity is through selected demonstration projects. These projects should be selected to offer a range of opportunities for rehabilitation techniques applied to a variety of mineral and site types and tailored to the Nova Scotian context. They should be able to:

- demonstrate the viability of rehabilitation work for new, mid term, end of term and abandoned operations and;
- provide improved information on associated costs, effectiveness of regulations and;
- promote the cause of rehabilitation activity throughout the Province.

The demonstration projects should address a number of variables: urban and rural locations, type of extraction activity, length of operation, the need for integration of both quarry and rehabilitation plans, cooperation of owners, and potential for success in terms of broader issues, e.g., the ongoing promotion of rehabilitation work.

A number of sites have been identified as possessing one or more of the above characteristics. They are outlined below with brief commentary. Photographs of the sites are contained in a separate volume.

Proposed Demonstration Sites

Site 1	Williams Lake Road Quarry - Abandoned	
	Owner:	Public Works
	Location:	Off Williams Lake Road in suburban Halifax
	Disturbed Area:	3-4 acres of cut rock face, dumps, staging and processing areas and side slope cuts into unconsolidated till
	Mineral Type:	Ironstone, Meguma Group rocks
	Use:	Highway Aggregates
	Ref.:	Inventory Site 12 - Technical Report

Commentary:

This site offers an excellent opportunity for a medium level of effort. The site is abandoned and hasn't been in operation since the late sixties or early seventies, is in a mixed density residential area, offers a number of options for techniques, is currently a visual blight in the community and has a number of potential after uses. It is highly unlikely the site will ever be re-opened due to the hazards inherent from blasting in a residential area and likely community opposition.

Site 2	Gateway Materials Ltd. - Mid Term	
	Owner:	Annapolis Basin Pulp and Paper and Gateway Materials Ltd.
	Location:	Kearney Lake Road in suburban Halifax
	Disturbed Area:	150 acres + of hard rock quarry, dumps, staging, processing, and bulk aggregate storage areas
	Mineral Type:	Quartzite - quarried portions, some granite reserve areas un-quarried
	Use:	Construction aggregates
	Ref.:	Inventory Site 11 - Technical Report

Commentary:

The site is adjacent to a rapidly expanding urban area, and pressure for on-site development will increase in years to come. The site presents a number of very interesting scenarios and approaches to technical methods for rehabilitation and at least one owner can be expected to be very cooperative. Proposed rehabilitation work has not been determined to date, and depending on chosen after uses would require a medium level of effort.

Site 3	Wentworth Quarry - Mid Term Operation	
	Owner:	Fundy Gypsum Co. Ltd.
	Location:	Windsor, Nova Scotia
	Disturbed Area:	1000 + acres including cut rock faces, active quarries, dump sites, Anhydrite stockpile sites, staging, and processing areas
	Mineral Type:	Gypsum, Anhydrite
	Use:	Construction Materials, e.g., wallboard, etc.
	Ref.:	Inventory Site 13 - Technical Report

Commentary:

The operation has been underway for many years, and is expected to continue at its current levels of operation for the foreseeable future. The company, of its own initiative, has undertaken rehabilitation work over the past twenty five years on selected areas, but not in conjunction with an overall quarry plan or from the standpoint of innovative after uses. Rehabilitation work to date has consisted of regrading, replanting with herbaceous and tree cover, and some monitoring.

The site is highly visible, located near an expanding rural community and offers a number of very interesting opportunities for innovative after uses. The operators are knowledgeable about rehabilitation and could be expected to be

interested in further work. This site could be an important example of progressive rehabilitation together with remedial rehabilitation on worked out portions.

Site 4 Kelly's Mountain - Proposed Operation

Owner:	Kelly Rock Ltd.
Location:	Kelly's Mountain, Englishtown, Cape Breton
Reserve Area:	n.a.
Mineral Type:	Granite
Use:	Construction Aggregates
Ref.:	

Commentary:

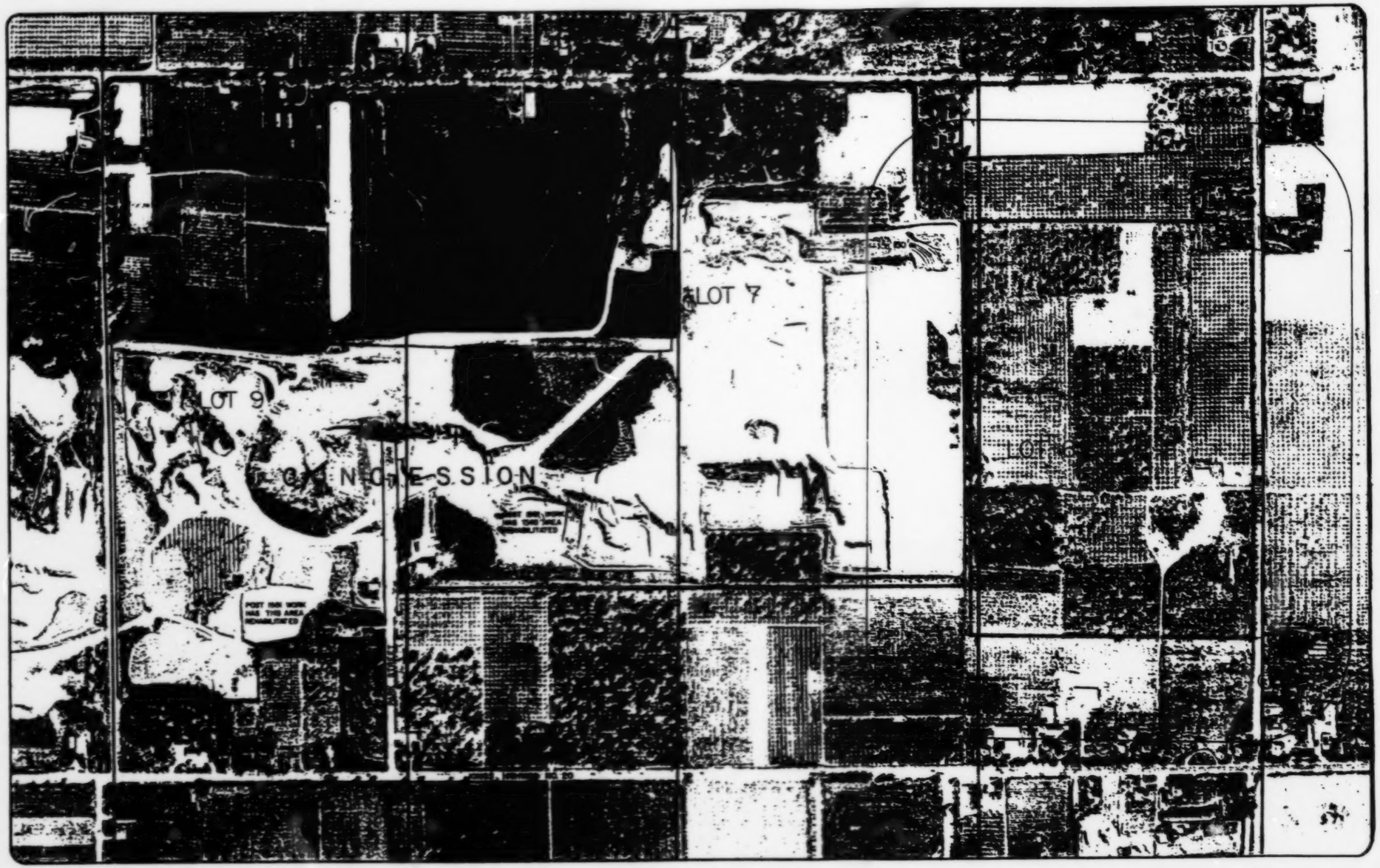
This is a proposed quarry site for which the operator is currently in the planning and application stages for commencing a new operation. The site offers an opportunity to coordinate a proposed quarry plan with a progressive rehabilitation plan from the outset of operations. The site appears to be particularly difficult in terms of ascertaining viable after uses and could present an important challenge to the developing of appropriate rehabilitation techniques and after uses. The operator has expressed an interest to cooperate in a joint demonstration venture.

Site 5 Dutch Settlement - Proposed Quarry

Owner:	Fundy Gypsum Co. Ltd.
Location:	Dutch Settlement
Disturbed Area:	Under exploration at this stage
Mineral Type:	Gypsum/Anhydrite?
Use:	Construction Materials, wallboard, etc.
Ref.:	N.S. Dept. of Mines and Energy

Commentary:

This site is a proposed quarry which would be a long term operation. It offers the possibility of demonstrating progressive rehabilitation and sequential after use in a new operation. It also offers the possibility of integrating a quarry plan and rehabilitation plan from commencement of operations.



LEGEND

- BOUNDARY OF AREA TO BE LICENSED
- LICENSED LIMIT OF LANDS OPERATED BY T.C.G. MATERIALS LIMITED
- RESIDENCE WITHIN 150m. OF AREA TO BE LICENSED
- LOT LINE

NOTES

1. Aerial photography by Northway Map Technology Limited, 1981.
2. Area to be licensed consists of part of lot 6, concession 7 and part of the road allowance between lots 6 and 7, Township of Pelham, Regional Municipality of Niagara.

"THIS SITE PLAN IS PREPARED FOR SUBMISSION TO THE MINISTRY OF NATURAL RESOURCES IN CONJUNCTION WITH AN APPLICATION FOR A PIT/QUARRY LICENCE UNDER THE PITS AND QUARRIES CONTROL ACT, 1971, (STATUTES OF ONTARIO, 1971, CHAPTER 96)"

prepared by: W.E. Coates and Associates Limited

SCALE 1:2500

SITE ENVIRONS

1 OF 5

william e. coates & associates limited
landscape architects
40 norwich street east, guelph, ontario.

drawn by: b.s.m.
checked by: [illegible]
drawing no.: 80-7-1

date: october, 1980
revisions: october, 1984
august, 1985-HBH
sept 1985 HBH
sept 6, 1985 HBH

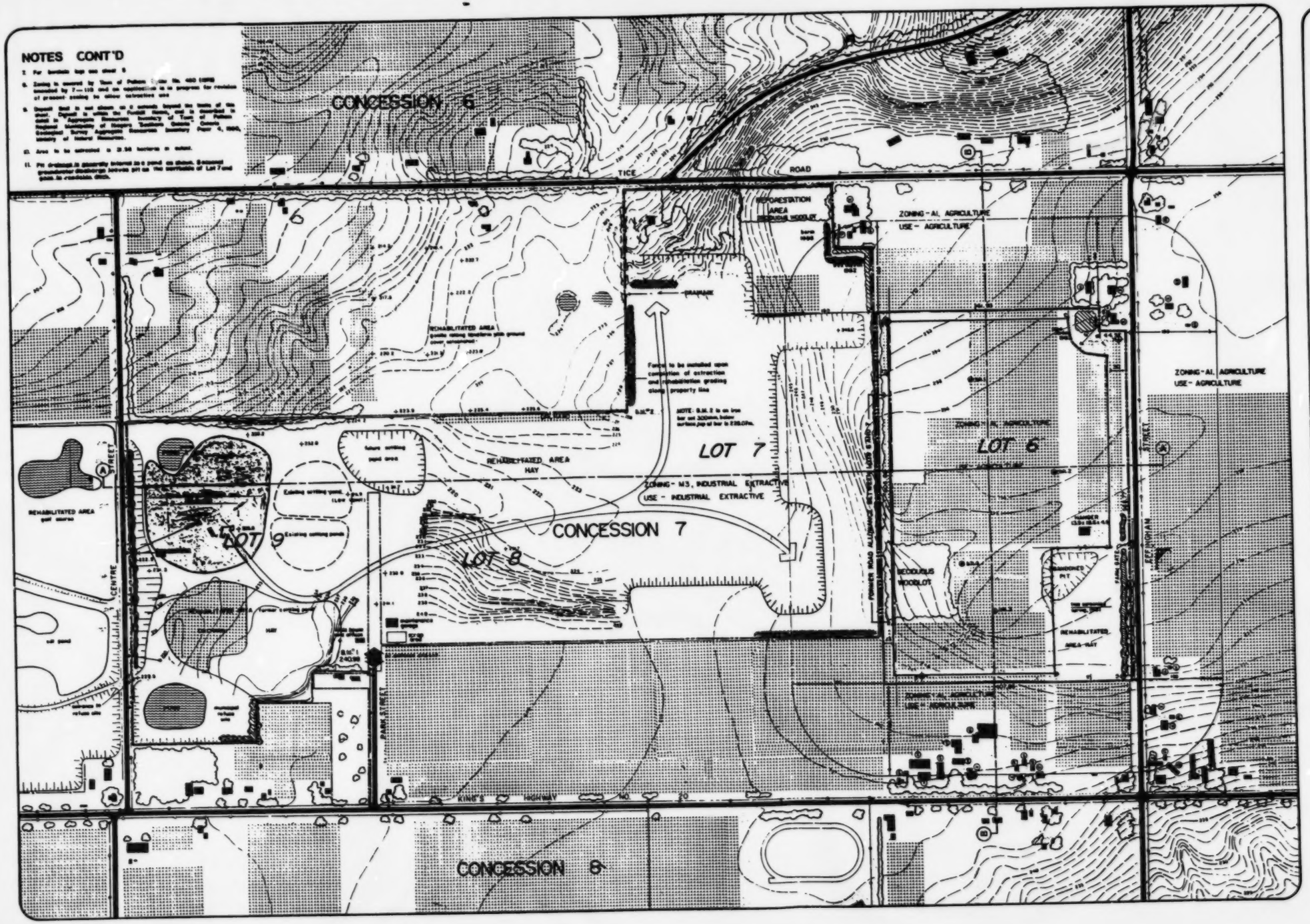
FONTHILL PIT
EXTENSION

TCG Materials Limited

P.O. Box 1390
Brantford, Ontario

NOTES CONT'D

2. For [illegible] see sheet 3.
6. Zoning is governed by Town of Paris [illegible] amended by T-[illegible] and an application is in progress for revision of present zoning to allow extraction and
9. Deposit data is not shown on a specific format on basis of the sheet. Deposit is within the Pleistocene Series and is generally a mixture of Aggregate, Sand, Gravelly of Town of Paris, Regional Municipality of Haldimand-Norfolk, Ontario, Ontario Geological Survey Aggregate Resources Inventory Paper 1, 1974, Ministry of Natural Resources.
10. Area to be extracted is 2.54 hectares in extent.
11. Pit drainage is generally toward the [illegible] pond on Block 3 proposed groundwater discharge [illegible] pit on the northeast of Lot 7 and goes to roadside ditch.



LEGEND

- BOUNDARY OF AREA TO BE LICENSED
- LICENSED LIMIT OF LANDS OPERATED BY T.C.G. MATERIALS LIMITED
- LIMIT OF EXTRACTION OR SETBACK
- PUBLIC ROAD
- PRIVATE ROAD
- HAUL ROUTE TO PLANT
- FENCE LINE
- PROPOSED FENCE
- HYDRO WOOD POLE LINE
- TELEPHONE WOOD POLE LINE
- COMBINATION HYDRO AND TELEPHONE WOOD POLE LINE
- BURIED TELEPHONE LINE
- BUILDING OR STRUCTURE (barn, garage, house, motel, pool, shed)
- SPOT ELEVATION
- ELEVATION CONTOUR
- WATER BODY
- GROUNDWATER MONITORING WELLS
- WOODY VEGETATION
- BORE HOLE
- EXTRACTION FACE
- EARTH BERM
- STOCKPILES
- EXISTING TREE COVER
- ORCHARD
- PIT DRAINAGE LINE

NOTES

1. Area to be licensed consists of part of lot 6, concession 7 and part of the road allowance between lots 6 and 7, Township of Paris, Regional Municipality of Haldimand and is 24.5 hectares (60.57 acres) in extent.
2. Topographical information obtained from National Topographic System map 30M/3b-973, Lockwood Survey Corporation Limited - GPO, and Technical Survey Services Ltd. - BBG. Information converted to metric by graphic control [illegible] contemporary topography information supplied by owners survey [illegible] and new grades for roads [illegible] by Proctor & Redfern [illegible]
3. Boundary dimensions were obtained from a survey description dated 1977 and a referenced plan dated 1979.
4. Pit features were identified from aerial photography and verified by a field inspection on Oct 1980.
5. All measurements are in metres.
6. Setback shown within boundary of area to be licensed is to be [illegible] in agreement with adjoining owners.
7. Water table in area is to be lowered varies from 203 to 208m a.s.l.

SCALE 1:2500

EXISTING CONDITIONS

2 OF 5

william a. coates & associates limited
landscape architects
40 norfolk street east, guelph, ontario

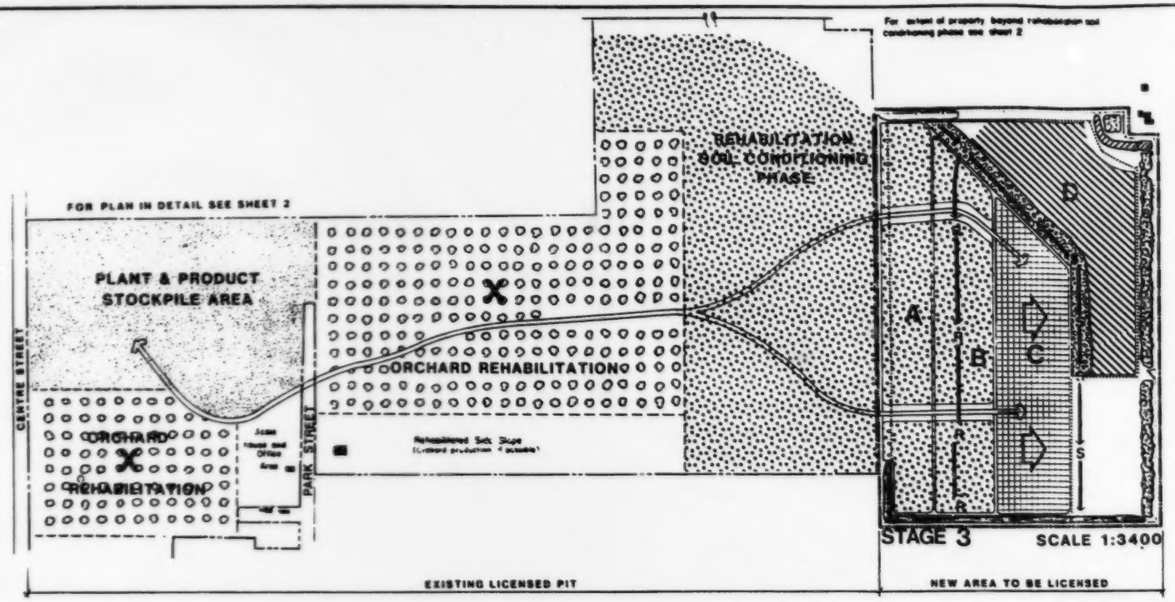
drawn by: [illegible]
checked by: [illegible]
drawing no.: 80-7-2

date: october, 1980
revisions: april, 1981
october, 1984
[illegible]

FONTHILL PIT
EXTENSION

TCG Materials Limited

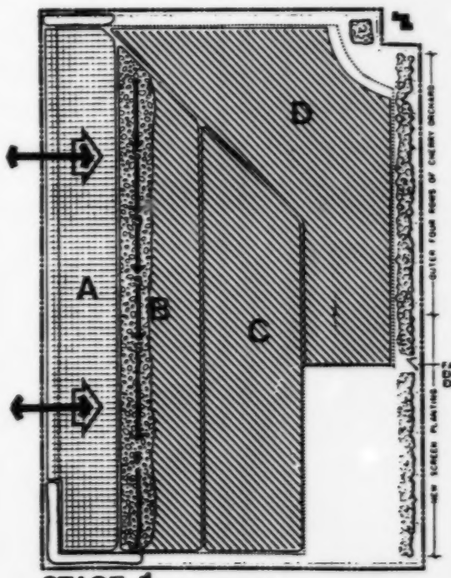
P.O. Box 1390
Brantford, Ontario



NOTES

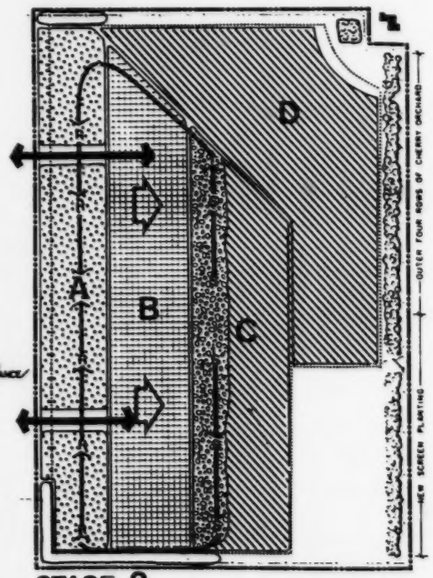
1. TOPSOIL AND SUBSOIL OVERBURDEN, "A" AND "B" SOIL HORIZONS ARE TO BE STRIPPED AND STOCKPILED SEPARATELY. TOPSOIL IS TO BE STRIPPED TO AN AVERAGE DEPTH OF 300mm. SUBSOIL IS TO BE STRIPPED TO AN AVERAGE DEPTH OF 600mm.
2. SEQUENCE IS TO PROCEED THROUGH OPERATING SEGMENTS IN ALPHABETIC ORDER.
3. FOR DETAILS OF REHABILITATION SEQUENCE SEE SHEET 4.
4. AGGREGATE PROCESSING FACILITIES WILL REMAIN IN THE PRESENT LOCATION WEST OF THIS AREA. NO FINISHED PRODUCT WILL BE SHIPPED DIRECTLY FROM THIS AREA OF APPLICATION OR TO EXTENSION LIMITS.
5. EXTRACTION WILL NOT TAKE PLACE BELOW THE GROUND WATER TABLE.
6. SURFACE DRAINAGE WILL FLOW WEST INTO THE ADJACENT PROPERTY AND/OR PERCOLATE VERTICALLY INTO PIT FLOOR.
7. NOISE CONTROL MEASURES SHALL BE AS FOLLOWS:
   A. THE ACOUSTIC BERM SHALL BE COMPLETED PRIOR TO UNDERTAKING ANY WORK IN ACOUSTIC ZONE 1. [illegible] OF THE BERM SHALL BE 4.5m MINIMUM.
   B. THE HAUL ROAD IN ACOUSTIC ZONE 1 SHALL BE LOCATED AS CLOSE TO THE BASE OF THE BERM AS POSSIBLE. THIS ROAD SURFACE SHALL BE GRADED REGULARLY TO PROVIDE A SMOOTH SURFACE. THIS ROAD SHALL BE LOCATED AT LEAST 1.0m BELOW EXISTING SURFACE ELEVATIONS IN ZONE 1. IN ACOUSTIC ZONE 2 THE TOP 1.0m OF DEPOSIT SHALL BE EXTRACTED BY POWER SHOVEL OPERATING, MOVED AS ACOUSTIC SHIELDING BERM. TRUCKS AND LOADERS SHALL BE USED ONLY AT DEPTHS GREATER THAN 1.0m BELOW ADJOINING SURFACE ELEVATIONS.
   C. OPERATION OF MACHINERY ON THE EXPANSION SITE WILL ONLY OCCUR BETWEEN THE HOURS OF [illegible] A.M. AND [illegible] P.M. SATURDAY THROUGH SATURDAY. NO OPERATION ON SUNDAYS OR STATUTORY HOLIDAYS.
   D. IN AREA D, EARTH MOVING OPERATIONS AT EXISTING SURFACE LEVELS WILL BE DONE IN EARLY MORNING AND/OR POSSIBLE.
   E. ALL MACHINERY ON THE SITE WILL HAVE EFFECTIVE MUFFLERS IN SERVICE AND SHALL BE MAINTAINED IN GOOD CONDITION TO MINIMIZE NOISE.
8. DUST CONTROL MEASURES SHALL BE AS FOLLOWS:
   A. MAINTAIN AS MUCH REMAINING VEGETATION COVER ON PIT FLOOR AND SLOPE AREAS AS POSSIBLE - CARRY OUT REGULAR PROGRESSIVE REHABILITATION.
   B. RESTRICT PIT HAUL AND SERVICE ROADS TO MINIMUM NUMBER AND LENGTH.
   C. ESTABLISH NEW ORCHARD PLANTINGS ON BOTH SIDES OF PERMANENT HAUL ROADS AS SOON AS POSSIBLE. THESE WILL LIMIT WIND MOVEMENT ACROSS ROADS.
   D. TREAT MAIN HAUL ROADS WITH WATER, CALCIUM OR OTHER SUITABLE BINDING MATERIALS DURING DRY PERIODS.
   E. ADJOINING ORCHARDS AND SCREEN PLANTINGS LOCATED NORTH, WEST AND SOUTH OF THE SITE WILL CONTRIBUTE TO REDUCTION OF WIND VELOCITIES ENTERING AND LEAVING THE SITE.
   F. VEGETATION WILL BE ESTABLISHED ON STORAGE BERMS TO AVOID CREATION OF DUST.
   G. PRODUCT STOCKPILES WILL BE SPRAYED WITH WATER WHERE NECESSARY.
9. EXTRACTION WITHIN STAGE D SHALL BE DEPENDENT UPON REHABILITATION TO TENDER FRUIT IN STAGE X BEING CARRIED OUT IN A SATISFACTORY MANNER. THIS SHALL MEAN THE PLANTING AND MAINTENANCE OF HEALTHY TENDER FRUIT ORCHARDS/VINEYARDS, WITH ALL REASONABLE MEASURES TAKEN TO ENSURE SATISFACTORY GROWTH AND PRODUCTION. SATISFACTORY GROWTH AND PRODUCTION WILL BE ASSESSED BY THE MINISTRY OF AGRICULTURE AND FOOD, VINELAND RESEARCH STATION, ONTARIO ON AN ANNUAL BASIS IN CONJUNCTION WITH THE MINISTRY OF NATURAL RESOURCES ANNUAL REVIEW OF THE SUMMARY LICENCE PURSUANT TO SECTIONS 7(1) and 7(2) OF THE PITS AND QUARRIES CONTROL ACT, R.S.O. 1980.

   SATISFACTORY GROWTH IS TO BE JUDGED BY REFERENCE TO ALL TREES PLANTED IN STAGE X AT THE DATE THE ASSESSMENT IS MADE. SATISFACTORY PRODUCTION IS TO BE JUDGED BY REFERENCE TO THE TREES PLANTED AS AT THE DATE THE LICENCE IS ISSUED PLUS TREES THAT COME INTO PRODUCTION THEREAFTER. THE MINISTRY OF NATURAL RESOURCES WILL SEND COPIES OF THE ANNUAL AGRICULTURAL MONITORING REPORTS TO THE TOWN OF PELHAM AND REGIONAL NIAGARA FOR THEIR USE.

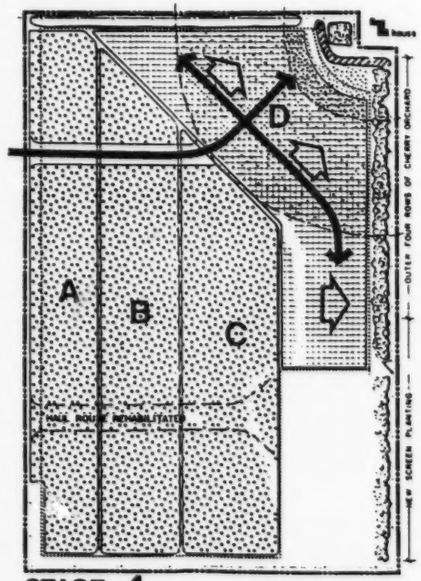


STAGE 1

NOTE: segment A stripping stored in storage berm

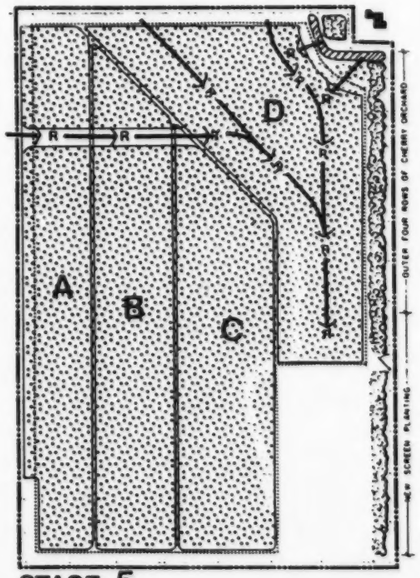


STAGE 2



STAGE 4

NOTE: balance of stripping from segment D will be used to rehabilitate segment C and go into storage berm for use in rehabilitating segment D



STAGE 5

LEGEND

- LICENSED LIMIT OF LANDS OPERATED BY TCG MATERIALS LIMITED
- BOUNDARY OF AREA TO BE LICENSED
- LIMIT OF EXTRACTION OR SETBACK
- A — OPERATING SEGMENT
- DIRECTION OF ADVANCE OF OPERATING FACE
- STRIPPING PRIOR TO EXTRACTION
- ACTIVE EXTRACTION AND WORK AREA
- REHABILITATION
- EXISTING AGRICULTURE
- HAUL ROUTE, PLANT TO OPERATING FACE
- S — STRIPPING TOPSOIL AND OVERBURDEN TO INTERIM STORAGE
- R — REPLACE TOPSOIL AND OVERBURDEN AS REHABILITATION COVER
- SURFACE DRAINAGE, MOVEMENT
- ORCHARD REHABILITATION
- VEGETATION SCREENING
- STORAGE BERM
- ACOUSTIC BERM
- ACOUSTIC ZONE 1
- ACOUSTIC ZONE 2
- FENCE, 1.5m, PER REGULATIONS

ACKNOWLEDGEMENTS: 1. Acoustic management by Aerovoutics Engineering Ltd. Rexdale, Ontario.
2. Soil and agricultural management by Ecological Services for Planning Ltd. Guelph Ont.

SCALE 1:2500

0 10 25 50 100 250 METRES

NORTH

OPERATIONS

3 OF 5

william e coates & associates limited
landscape architects
40 norwich street east guelph ontario

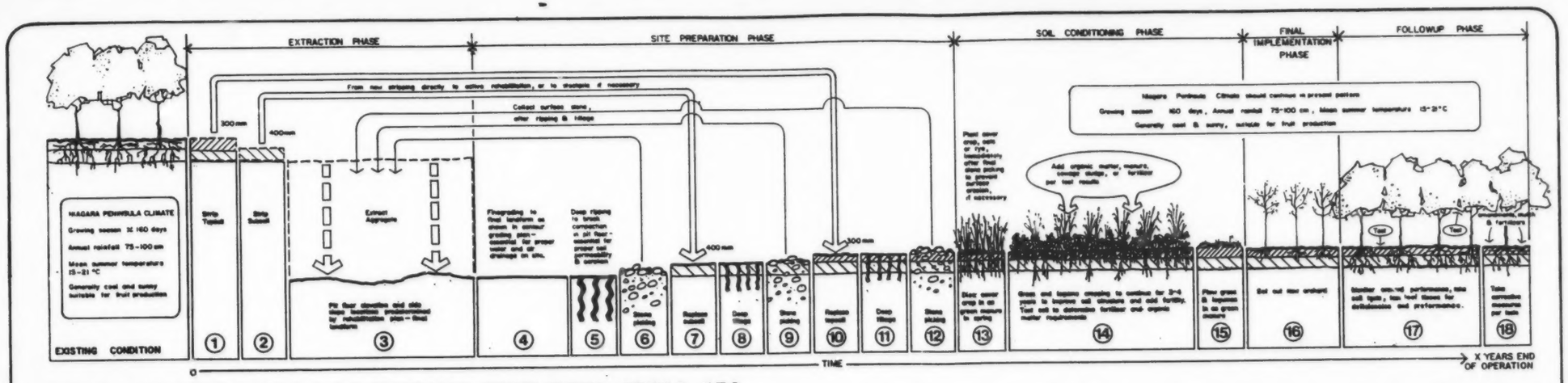
drawn by BGB
checked by [illegible]
drawing no 80-7-3

date october, 1980
revisions sept. 1981
oct. 1984
august, 1985-HBH, sept 1990 HBH
oct 1990 HBH
jan 1991 HBH

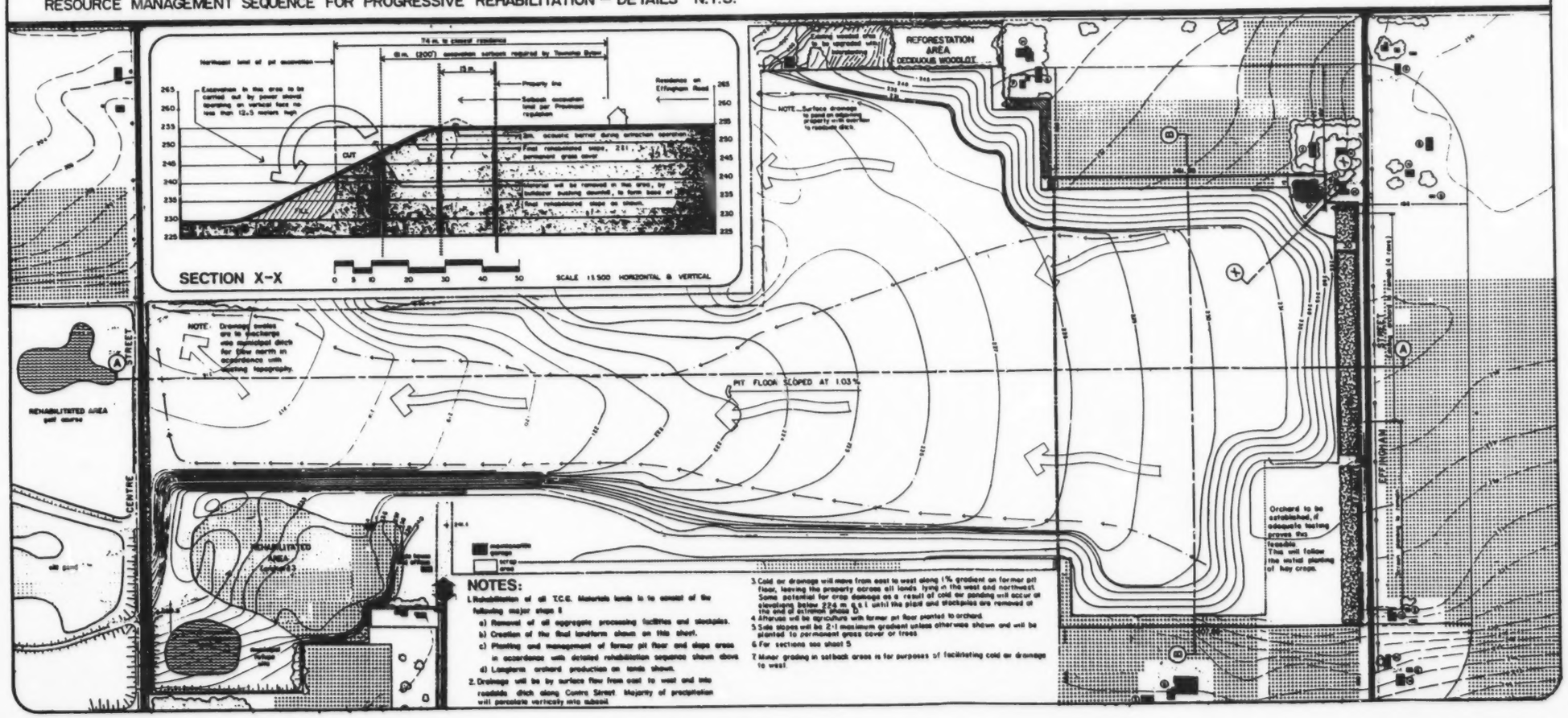
FONTHILL PIT
EXTENSION

TCG Materials Limited

P.O. Box 1580
Brantford Ontario



RESOURCE MANAGEMENT SEQUENCE FOR PROGRESSIVE REHABILITATION – DETAILS N.T.S.



NOTES:

1. Rehabilitation of all T.C.G. Materials lands is to consist of the following major steps:
   a) Removal of all aggregate processing facilities and stockpiles.
   b) Creation of the final landform shown on this sheet.
   c) Planting and management of former pit floor and slope areas in accordance with detailed rehabilitation sequence shown above.
   d) Longterm orchard production on lands shown.
2. Drainage will be by surface flow from east to west and into roadside ditch along Centre Street. Majority of precipitation will percolate vertically into subsoil.
3. Cold air drainage will move from east to west along 1% gradient on former pit floor, leaving the property across all lands lying in the west and northwest. Some potential for crop damage as a result of cold air ponding will occur at elevations below 224 m. a.s.l. until the plant and stockpiles are removed at the end of minimal phase D.
4. Afteruse will be agriculture with former pit floor planted to orchard.
5. Side slopes will be 2:1 maximum gradient unless otherwise shown and will be planted to permanent grass cover or trees.
6. For sections see sheet 5.
7. Minor grading in setback areas is for purposes of facilitating cold air drainage to west.

LEGEND

- BOUNDARY OF AREA TO BE LICENSED
- LICENSED LIMIT OF LANDS OPERATED BY T.C.G. MATERIALS LIMITED
- LIMIT OF EXTRACTION OR SETBACK
- PUBLIC ROAD
- PRIVATE ROAD
- FENCE LINE
- HYDRO WOOD POLE LINE
- TELEPHONE WOOD POLE LINE
- COMBINATION HYDRO AND TELEPHONE WOOD POLE LINE
- BURIED TELEPHONE LINE
- BUILDING OR STRUCTURE (barn, garage, house, motel, pool, shed)
- SPOT ELEVATION
- ELEVATION CONTOUR
- WATER BODY
- WOODY VEGETATION
- BORE HOLE
- EXTRACTION FACE
- EARTH BERM
- STOCKPILES
- ORCHARD
- DRAINAGE SWALE
- EXISTING TREE SCREEN
- MAIN DIRECTION OF COLD AIR FLOW

SCALE 1:2500

REHABILITATION PLAN

4 OF 5

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drawn by: [illegible]
checked by: [illegible]
drawing no.: 80-7-4
date: october, 1980
revisions: [illegible]

FONTHILL PIT EXTENSION

TCG Materials Limited

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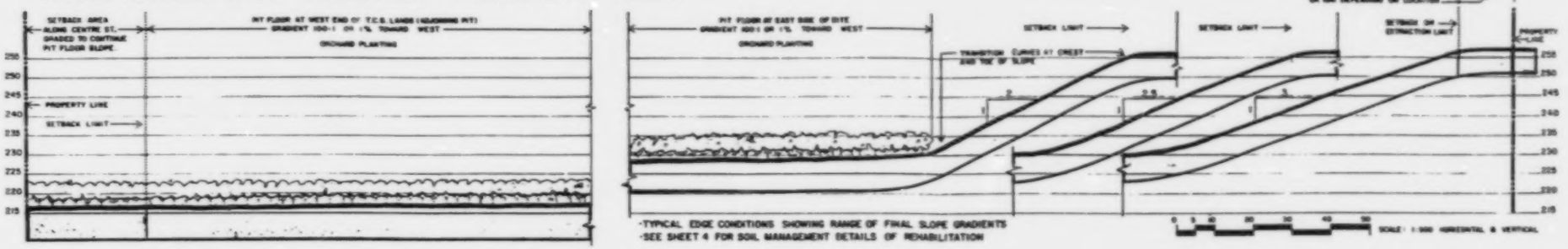
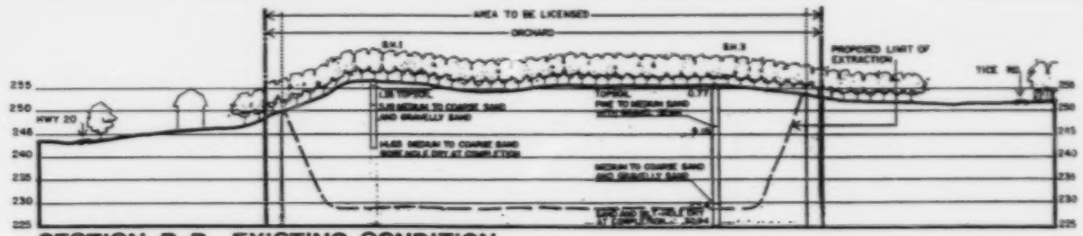
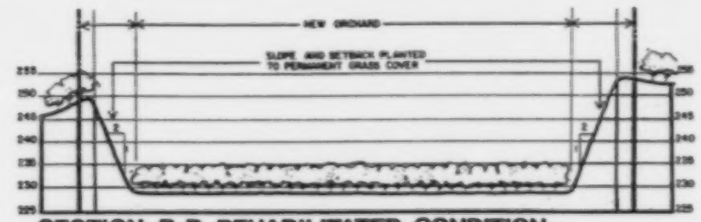
TYPICAL REHABILITATED CONDITIONS · SLOPES & PIT FLOOR



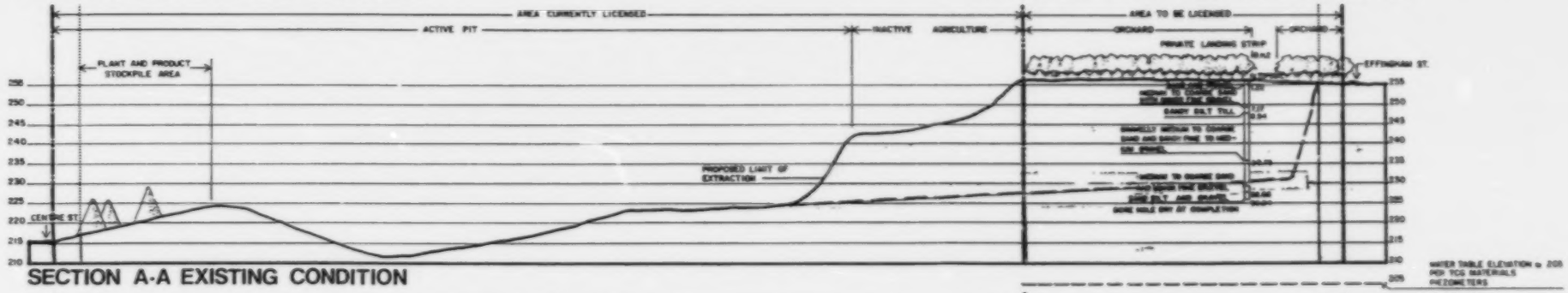
·TYPICAL EDGE CONDITIONS SHOWING RANGE OF FINAL SLOPE GRADIENTS
·SEE SHEET 4 FOR SOIL MANAGEMENT DETAILS OF REHABILITATION



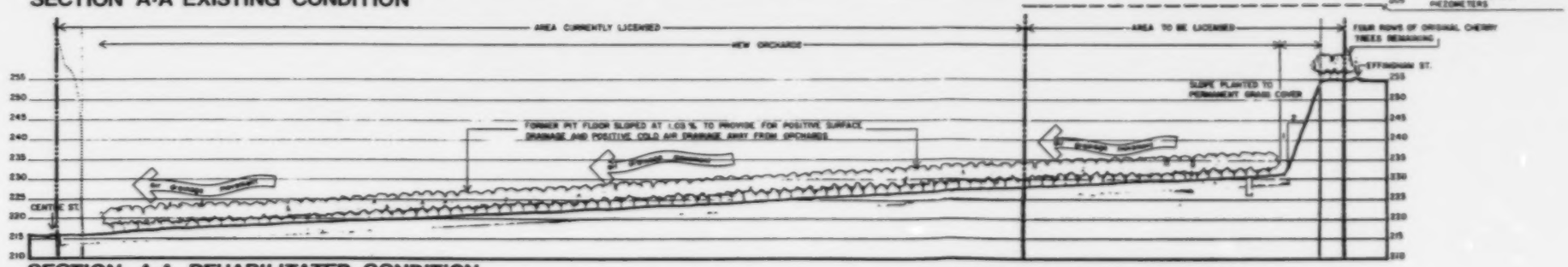
SECTION B·B EXISTING CONDITION



SECTION B·B REHABILITATED CONDITION



SECTION A·A EXISTING CONDITION



SECTION A·A REHABILITATED CONDITION

SCALES: HORIZONTAL 1:2500, VERTICAL 1:500

LEGEND

- BOUNDARY OF AREA TO BE LICENSED
- LIMIT OF EXCAVATION - SETBACK LIMIT
- BORE HOLE

NOTES

·BORE HOLES No.1 & No.2 WERE DRILLED DEEPER THAN THE PROPOSED PIT FLOOR, NEITHER HOLE INTERCEPTED THE WATER TABLE AT ANY POINT. THE PROPOSED PIT EXTENSION WILL BE DRY, COMPLETELY ABOVE THE WATER TABLE AND WILL HAVE NO EFFECT ON THE LOCAL GROUND WATER SYSTEM.

·FOR PLAN LOCATION OF SECTIONS SEE SHEETS 1,2 & 4

·FOR DETAILS OF REHABILITATION IMPLEMENTATION SEE SHEETS 3 & 4

ACKNOWLEDGEMENT: BORE HOLE INFORMATION IS FROM "GRANULAR EVALUATION OF THE HAUN AND WOODGATE PROPERTIES FOR T.C.G. MATERIALS LTD., PROJECT No. 79-135, JAN.1980, BY GARTNER LEE ASSOCIATES LTD.

SECTIONS 5 OF 5

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FONTHILL PIT
EXTENSION

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